

# 聚酰亚胺专利分析报告

2011 年 4 月 20 日

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## 一、数据来源、分析工具说明

### 研究目的

本报告针对聚酰亚胺（Polyimide）的国内外专利进行分析，以期对聚酰亚胺的相关专利有一个比较全面的了解。

### 专利产出分析报告说明

#### 数据来源

本报告的分析对象为与聚酰亚胺相关专利，专利数据来源为 Derwent Innovation Index (DII) 专利数据库，该专利数据库收录了来自全球 40 多个专利发行机构的 1200 多万个基本发明，专利覆盖范围可追溯到 1963 年，引用信息可追溯到 1973 年，是检索全球专利的最权威的数据库。

专利数据检索策略为：标题=(Polyimide)

入库时间：2001-2010 年

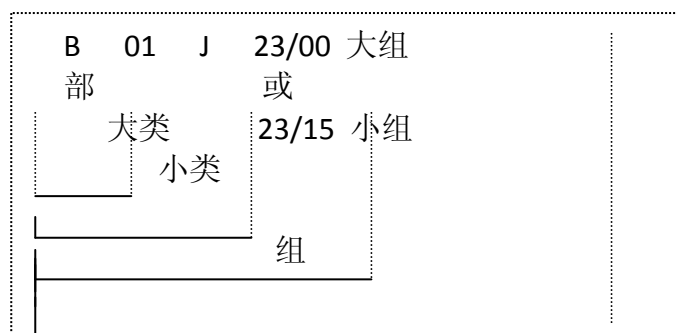
统计日期截止于 2011 年 4 月 19 日。

专利数据的分析工具主要采用 Thomson Data Analyzer 分析软件，同时采用 DERWENT 分析家作为补充分析工具。

#### 技术分类

为了清晰准确的了解 LLNL 的专利技术领域分布，探索其分布趋势和集中分布点，我们参照了国际专利分类（IPC）表的分类体系，对专利产出进行了技术分类。

国际专利分类（IPC）体系如下



#### 术语解释

##### 专利家族

随着科学技术的发展,专利技术的国际交流日益频繁。人们欲使其一项新发明技术获得多国专利保护,就必须将其发明创造向多个国家申请专利,由此产生了一组内容相同或基本相同的文件出版物,称一个专利家族。专利家族可分为狭义专利家族和广义专利家族两类。广义专利家族指一件专利后续衍生的所有不同的专利申请,即同一技术创造后续所衍生的其它发明,加上相关专利在其它国家所申请的专利组合。本报告所述专利家族都是指广义的专利家族。

本报告所述专利家族都来自 Derwent 数据库中的 Derwent 专利家族。Derwent 一条记录代表一条专利家族。Derwent 的专家对第一篇进入 Derwent 数据库的专利称为基本专利(Basic Patent),以后对进入 Derwent 数据库的每篇专利进行检查。如果权利要求是在基本专利范围内,则添加到基本专利的记录中。如有新的优先权,基本专利无法覆盖,则将该专利作为基本专利,重新生成一条记录。

### **基本专利、同族专利**

在同一专利家族中,每件文件出版物互为同族专利。德温特出版公司规定先收到的主要国家的专利为基本专利,后收到的同一发明的专利为同族专利。

### **其他说明：专利件次**

由于软件局限,在进行专利权人分析时,我们实现对单个专利权人的专利数量进行了统计,但没有对这些专利权人之间是否共同拥有同一件专利进行判断,因此计算这些专利权人的专利累积量时采用了把单个专利权人的专利数量累加的方式,所以这时的专利累积量比专利实际总量大,我们称之为专利件次。采用专利件次并不影响对结论的判断。

## 二、国际专利趋势分析

### 1、专利产出与时间趋势分析

截至统计日期，在检索范围内共检索到聚酰亚胺的相关专利 6833 件（其中 2010 年的数据统计不完全），从近十年的专利数量来看，年均专利产出约为 641 件次。其中 2007 年的专利数量最多，达到了 859 件次。但是近三年聚酰亚胺的专利产出有所减少，和 2008 年相比，2009 年的专利数量减少了近 40%。

表 2.1.1 和图 2.1.1 显示了聚酰亚胺专利数量的年度统计情况。

表 2.1.1 聚酰亚胺专利数量的年度统计（2001-2010 年）

年份	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	累计
专利数量	644	656	668	697	735	760	859	792	478	121	6410

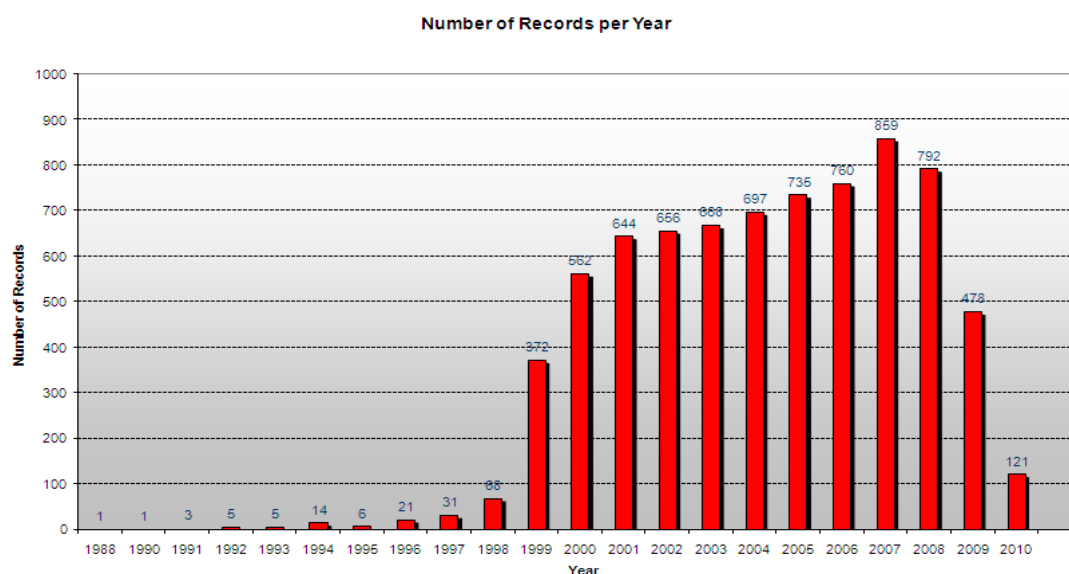


图 2.1.1 聚酰亚胺专利数量的年度统计（入库时间 2001-2010 年）

### 2、重要专利权人分析

在 2001-2010 年入 DII 数据库的聚酰亚胺技术专利中，涉及的专利权人有 2000 余个机构及个人，其中拥有 100 件以上专利的 11 家机构全是日本的公司，分别是日本钟化株式会社 (KANEKA CORP)、日本的宇部兴产公司 (UBE IND LTD)、东洋纺织 (TOYOBO KK)、东丽杜邦股份有限公司 (DU PONT TORAY CO LTD)、三井化学株式会社 (MITSUI CHEM INC)、日东电工集团 (NITTO DENKO CORP)、新日铁化学 (NIPPON STEEL CHEM CO)、东丽株式会社 (TORAY IND INC)、日立化成工业 (HITACHI CHEM CO LTD)、日本合成橡胶公司 (JSR CORP)、富士施乐株式会社 (FUJI XEROX CO LTD) 等，如图 2.2.1

所示。中科院化学研究所拥有 17 件专利，全球排名第 73 位。

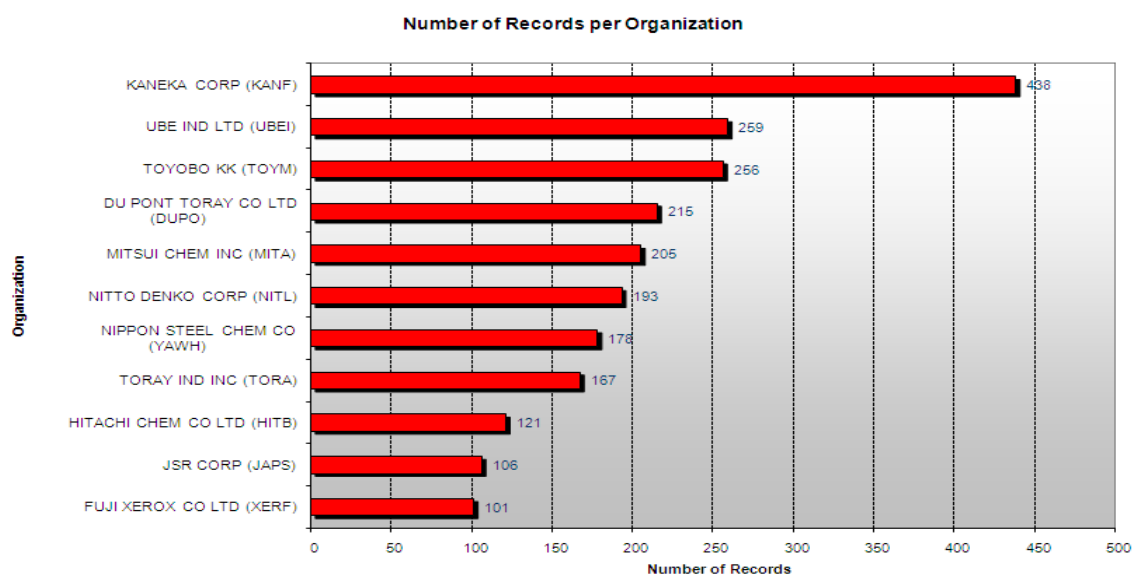


图 2.2.1 重要专利权人分析

表 2.2.1 所示为排名前 20 位的专利权人,所拥有的专利累计 2918 件次, 约占件次总量的 42.7%。其中除了排名第 18 位的科隆工业股份有限公司 (KOLON IND INC) 外, 其他均是日本企业。

表 2.2.1 重要专利权人 (TOP20)

序号	专利权人	专利数量	所占百分比
1.	KANEKA CORP	438	6.41%
2.	UBE IND LTD	259	3.79%
3.	TOYOBO KK	256	3.75%
4.	DU PONT TORAY CO LTD	215	3.15%
5.	MITSUI CHEM INC	205	3%
6.	NITTO DENKO CORP	193	2.82%
7.	NIPPON STEEL CHEM CO	178	2.61%
8.	TORAY IND INC	167	2.44%
9.	HITACHI CHEM CO LTD	121	1.77%
10.	JSR CORP	106	1.55%
11.	FUJI XEROX CO LTD	101	1.48%
12.	SHINETSU CHEM IND CO LTD	99	1.45%
13.	NISSAN CHEM IND LTD	84	1.23%
14.	HITACHI CABLE LTD	80	1.17%
15.	HITACHI KASEI DUPONT ICROSYSTEMS KK	74	1.08%
16.	TEIJIN LTD	73	1.07%
17.	DU PONT DE NEMOURS & CO E I	69	1%
18.	KOLON IND INC	68	1%
19.	SUMITOMO BAKELITE CO LTD	67	0.98%
20.	UNITIKA LTD	65	0.95%

### 3、核心专利发明人分析

在近十年的聚酰亚胺技术发明人中，有 24 位发明人拥有的专利数量不少于 30 件次，其中日本东洋纺织（TOYOBO KK）的 MAEDA S 以拥有专利 178 件次名列榜首，表 2.3.1 显示了专利数量不少于 30 件次的发明人专利数量情况。

表 2.3.1 聚酰亚胺技术专利数量≥30 件次的发明人列表

专利发明人	专利数量	所占百分比
MAEDA S	178	2.61%
OKUYAMA T	102	1.49%
YOSHIDA T	89	1.30%
KAWAHARA K	73	1.07%
KIKUCHI T	56	0.82%
SAWAZAKI K	46	0.67%
TSUTSUMI M	46	0.67%
FUJIWARA H	45	0.66%
HASEGAWA M	43	0.63%
OGUNI M	42	0.61%
LI G	39	0.57%
MAEDA A	38	0.56%
ITO T	37	0.54%
YANAGIDA M	35	0.51%
ISHIKAWA H	33	0.48%
LI J	33	0.48%
OKAMOTO K	33	0.48%
ONO K	33	0.48%
SONG S M	32	0.47%
MIYAMOTO T	31	0.45%
TANAKA S	31	0.45%
KANESHIRO N	30	0.44%
MURAKAMI M	30	0.44%
NOJIRI H	30	0.44%

### 4、主要技术构成分析

根据每个专利全部的国际分类号（IPC 分类号）进行统计分析，得到出现频次在 200 次以上的 TOP16 IPC 分类号（图 2.4.1），不同 IPC 分类号代表的含义见附录 1。可以看出，聚酰亚胺相关技术的研究主要集中在以下领域：首先是“用碳—碳不饱和键以外的反应得到的高分子化合物”（C08G）方面的研究，共有 2548 件专利，约占专利总量的 37%；其次是“高分子化合物的组合物”（C08L）、“层状产品，即由扁平的或非扁平的薄层，例如泡沫状的、蜂窝状的薄

层构成的产品”（B32B）、“加工;配料的一般工艺过程”（C08J）、“半导体器件;其他类目未包含的电固体器件”（H01L）、“印刷电路;电设备的外壳或结构零部件;电气元件组件的制造”（H05K）等技术领域，这些技术类别的专利均在 1000~2000 件之间。

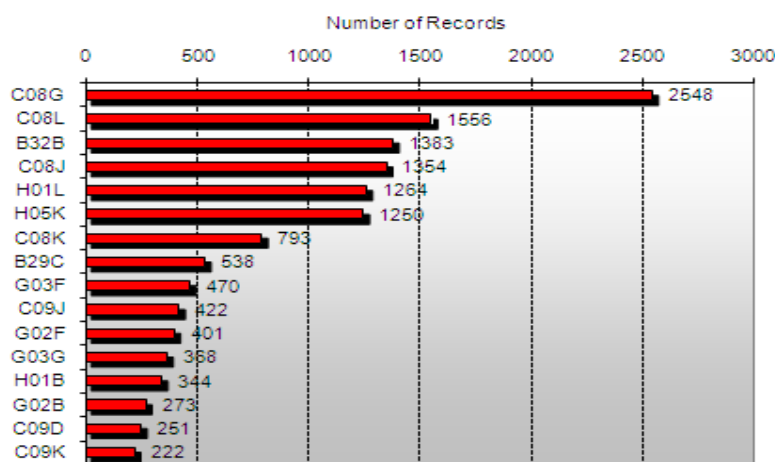


图 2.4.1 出现频次最高的 IPC 分类号

表 2.4.1 聚酰亚胺技术专利的主要技术构成

序号	技术类别	主要专利权人	主要受理专利机构
1.	C08G	KANEKA CORP [236]; TOYOBO KK [129]; UBE IND LTD [128]	JP [1905]; KR [222]; CN [203]
2.	C08L	KANEKA CORP [141]; DU PONT TORAY CO LTD [82]; TORAY IND INC [80]	JP [1162]; CN [174]; US [134]
3.	B32B	KANEKA CORP [162]; UBE IND LTD [113]; NIPPON STEEL CHEM CO [107]	JP [1099]; US [137]; KR [81]
4.	C08J	DU PONT TORAY CO LTD [160]; KANEKA CORP [149]; TOYOBO KK [98]	JP [1026]; CN [141]; KR [111]
5.	H01L	HITACHI CHEM CO LTD [59]; HITACHI KASEI DUPONT MICROSYSTEMS KK [57]; TORAY IND INC [48]	JP [959]; US [143]; KR [116]
6.	H05K	KANEKA CORP [130]; NIPPON STEEL CHEM CO [110]; DU PONT TORAY CO LTD [74]	JP [1062]; KR [85]; CN [50]
7.	C08K	KANEKA CORP [66]; NITTO DENKO CORP [45]; DU PONT TORAY CO LTD [44]	JP [575]; CN [97]; US [77]
8.	B29C	KANEKA CORP [74]; UBE IND LTD [52]; FUJI XEROX CO LTD [44]	JP [447]; US [40]; CN [34]
9.	G03F	HITACHI KASEI DUPONT MICROSYSTEMS KK [62]; KANEKA CORP [45]; ASAHI KASEI KK [33]	JP [391]; KR [34]; CN [29]



10.	C09J	KANEKA CORP [73]; HITACHI CHEM CO LTD [56]; MITSUI CHEM INC [39]	JP [352]; CN [26]; KR [26]
11.	G02F	JSR CORP [53]; NISSAN CHEM IND LTD [41]; CHISSO CORP [27]	JP [284]; KR [65]; US [29]
12.	G03G	NITTO DENKO CORP [93]; FUJI XEROX CO LTD [86]; RICOH KK [31]	JP [336]; US [18]; CN [9]
13.	H01B	SUZHOU JUFENG METAL CABLE CO LTD [26]; UBE IND LTD [20]; HITACHI CABLE LTD [17]	JP [205]; CN [86]; US [37]
14.	G02B	NITTO DENKO CORP [28]; KANEKA CORP [22]; MITSUI CHEM INC [16]	JP [214]; US [31]; CN [12]; KR [12]
15.	C09D	UNITIKA LTD [15]; KANEKA CORP [13]; CHISSO CORP [12]	JP [206]; US [19]; CN [18]
16.	C09K	JSR CORP [29]; NISSAN CHEM IND LTD [21]; CHEIL IND INC [17]	JP [121]; KR [52]; US [30]

## 5、主要优先权国家/地区分析

图 2.5.1 对聚酰亚胺专利的优先权国家/地区进行了分析，如图所示，日本为本领域的主要优先权国家，其次是中国、美国和韩国，这些国家都拥有 600 余件专利，中国的台湾地区拥有约 137 件专利优先权。

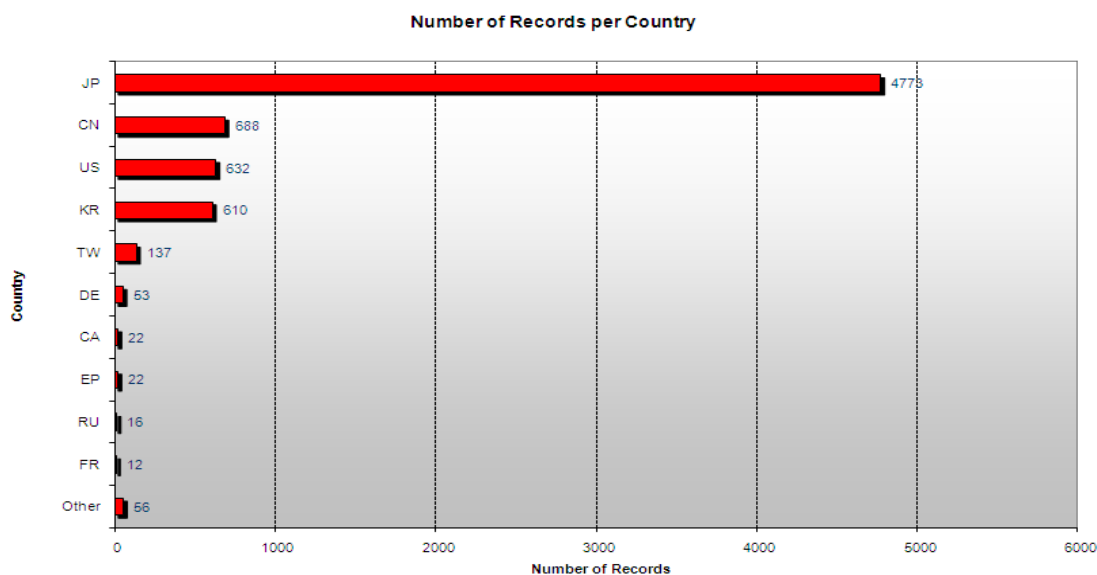


图 2.5.1 主要优先权国家/地区分析

图 2.5.2 显示了从事聚酰亚胺相关研究的主要国家/地区的重点研究技术的分布情况。由图可见，日本的聚酰亚胺技术发展在全球处于绝对领先地位，尤其在“用碳—碳不饱和键以外的反应得到的高分子化合物”（C08G）、“高分子化合物的组合物”（C08L）、“层状产品，即由扁平的或非扁平的薄层，例如泡沫状的、蜂窝状的薄层构成的产品”（B32B）、“加工;配料的一般工艺过程”（C08J）、“印刷电路;电设备的外壳或结构零部件;电气元件组件的制造”（H05K）等领域，相关专利拥有量均超过了 1000 件。

中国的聚酰亚胺技术研究主要集中在“用碳—碳不饱和键以外的反应得到的高分子化合物”（C08G）、“高分子化合物的组合物”（C08L）、“加工;配料的一般工艺过程”（C08J）、“使用无机物或非高分子有机物作为配料”（C08K）、“电缆;导体;绝缘体;导电、绝缘或介电材料的选择”（H01B）等领域，相关专利技术发展仅次于日本。

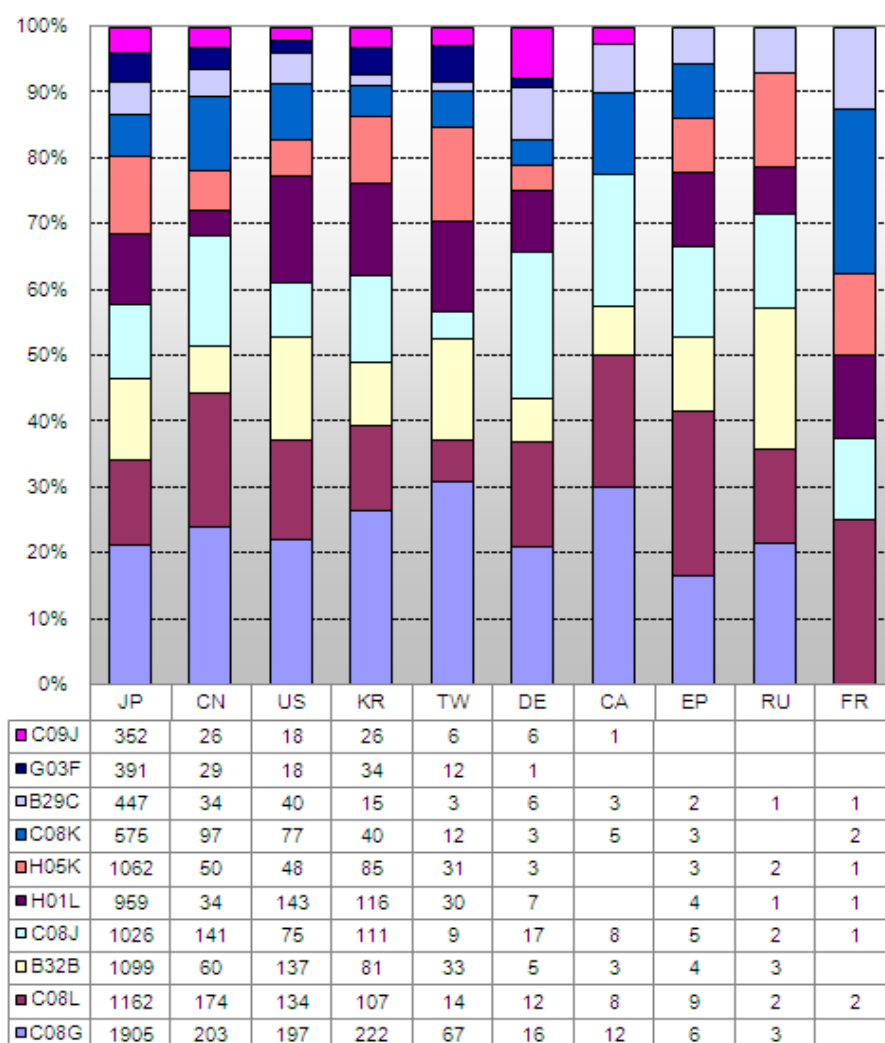


图 2.5.2 主要优先权国家/地区重点研究技术分布情况

## 6、高被引专利分析

当一件专利被引用，那么，这项专利很可能包含一种重要的技术发展趋势，很多后来的专利是在其基础上研究出来的，其被引用量高，表示其影响力大，具有明显的技术发展优势。机构若拥有许多被大量引用的专利，除表示比其竞争对手更具优势外，也可能表示该机构拥有许多的专利。表 2.6.1 列出了被引次数不小于 30 次的专利（家族），其详细信息见附录二。

表 2.6.1 聚酰亚胺技术高被引专利

序号	专利名称	专利权人	同族专利	被引次数
1.	Fabrication of transistor(s) e.g., thin film transistor used in electrophoretic display by utilizing substrate containing polyphenylene polyimide	E-INK CORP; DENIS K L; CHEN Y; DRZAIC P S; JACOBSON J M; KAZLAS P T	WO200180287-A; WO200180287-A2; US2002019081-A1; AU200153575-A; EP1275156-A2; KR2002089479-A; JP2003531487-W; CN1441967-A; US6825068-B2; US2005067656-A1; CN1237623-C; US7365394-B2; KR767233-B1; EP1275156-B1; DE60139463-E	89
2.	Probe membrane construction for integrated circuit testing, involves patterning polyimide layer around depressions which are created within substrate	GLEASON R; BAYNE M A; SMITH K; LESHNER T; KOXXY M; CASCADE MICROTECH INC	US2001030549-A1; US6860009-B2	58
3.	Resonator structure for RF filter used in mobile phone, has polyimide material layer that is formed in peripheral region enclosing center region of piezoelectrically excitable area	NOKIA MOBILE PHONES LTD; NOKIA CORP; AVAGO TECHNOLOGIES WIRELESS IP SINGAPORE	WO200106646-A; EP1196989-A; US6788170-A; WO200106646-A1; AU200062844-A; EP1196989-A1; CN1361939-A; JP2003505905-W; US6788170-B1; JP3740061-B2; CN1201486-C; EP1196989-B1; DE60042486-E	46
4.	Preparation of porous polyimide dielectric materials for electronic components, involves subjecting cured polyimide dielectric matrix material film to conditions which remove porogen soluble in uncured matrix material	SHIPLEY CO LLC	US6391932-B1	43
5.	Polyimide film forming method for semiconductor device manufacture, involves solidifying film on peripheral	TOKYO ELECTRON LTD; SAKAMOTO Y;	US6565928-B1; JP2000323471-A; US6284044-B1; US2001041229-A1;	42

	edge portion of wafer, after removing film formed on circumferential portion of wafer	YATEGASHI H	US6565928-B2	
6.	Wafer attachment process used for forming bolometer involves forming two wafers with connections on surfaces, bonding wafer surfaces with polyimide layers, etching holes through polyimide layers and sputtering conductive material into holes	HONEYWELL INC;	WO200109948-A; EP1198835-A; WO200109948-A1; AU200067546-A; US6287940-B1; EP1198835-A1; KR2002020954-A; CN1377512-A; JP2003506871-W; KR704249-B1; IN200200147-P1; CA2381081-C	40
7.	Flexible tube for use as medical electrode catheter comprises inner and outer wall layers comprising polyimide matrix, with inner layer containing number of braid elements	HELPS DODGE HIGH PERFORMANCE CONDUCTORS	US6213995-B1	36
8.	Membrane probe constructing method for integrated circuit testing, involves forming polyimide layer over conductive material formed in depression of substrate, after which the substrate is removed	CASCADE MICROTECH INC	US6256882-B1	34
9.	Flexible microchannel heat exchanger for, e.g. laptop computer cooling, includes channel layer formed from heat-sealable polyimide material and having fluid flow microchannels connected with fluid distribution channels of header layer	UNIV ILLINOIS	US2003213580-A1; US6827128-B2	31
10.	Electrical connector for high-speed communication, has phosphor bronze ground plane plated and etched on planar polyimide dielectric	FCI; EVANS R F; FCI AMERICAS TECHNOLOGY INC; FCI FRAMATOME CONNECTORS INT; FCI FRANCE CHIRURGIE INSTR SA	EP1311038-A3; EP1311038-A2; US2003092320-A1; CA2406428-A1; JP2003187920-A; CN1419320-A; KR2003040078-A; US6848944-B2; US2005118869-A1; EP1311038-B1; DE60213053-E; DE60213053-T2; CN1305179-C; US7310875-B2; TW566681-U	31

中科院化学研究所的专利中，有 2 件专利（家族）被引用了 1 次，分别是：

1) 标题：New polyimide resin for metal foil laminated board used in packaging substrate of super-large scale integrated circuit (CN101343362-A)

2) 标题：Short-fiber reinforced polyimide composite material, and its preparing method and use (CN1676548-A; CN1320060-C)

### 三、技术发展趋势分析

图 3.1 为聚酰亚胺专利发明人数量年度分布图，图中蓝色部分为当年度中此前已经存在的发明人，红色表示当年新出现的发明人。分析图 3.1 中数据可知，聚酰亚胺发明人的总量和增量在 2000~2007 年间出现快速持续的增长，表明国际上聚酰亚胺技术研发队伍在不断庞大，而且持续地加速增长，国际厂商和研发机构对聚酰亚胺的研发正不断地增量投入人力。但以 2007 年为转折点，近三年来，发明人的总量和增量都呈下降趋势，虽然仍有大量新人员投入到聚酰亚胺的技术研发中，但增幅在不断减少。

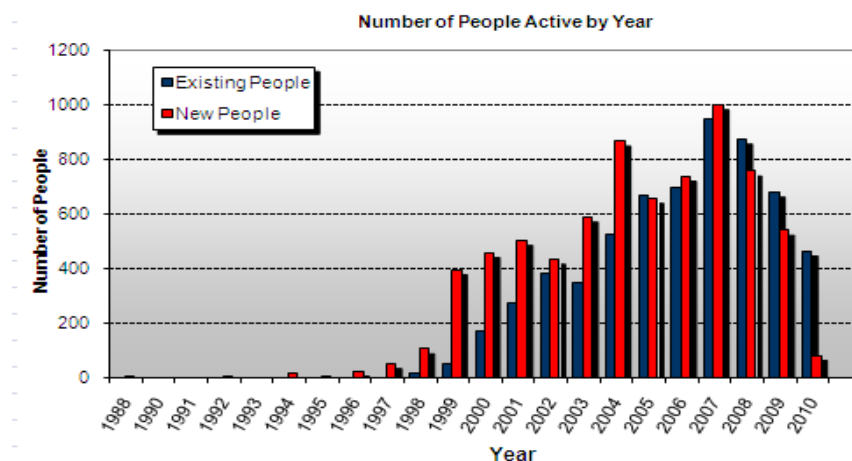


图 3.1 发明人数量年度分布情况

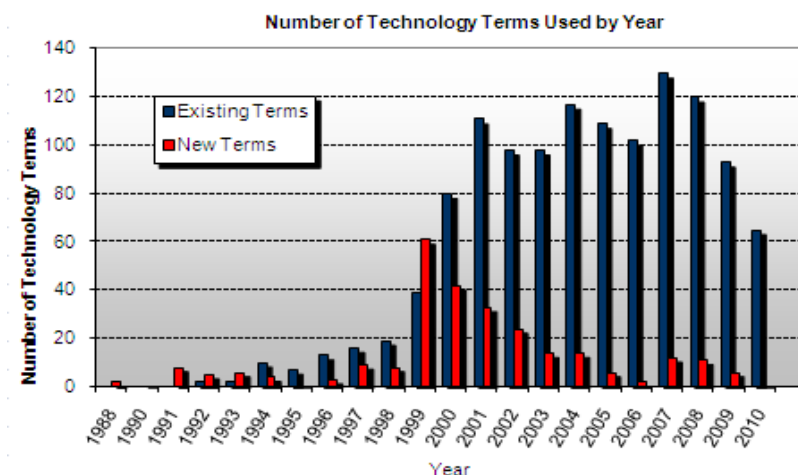


图 3.2 专利技术种类年度分布情况

图 3.2 为聚酰亚胺技术种类（IPC 小类）年度分布图，图中蓝色部分为当年度中，此前已经存在的专利技术种类，红色表示当年新出现的专利技术种类。图中可以看出，聚酰亚胺技术在 2000-2007 年有着较稳定的发展，但在最近 3 年的发展有所减弱。而且，近五年来鲜有新技术产生。

表 3.1 所示为近三年（2008-2010 年）聚酰亚胺专利技术发展趋势

近三年新出现的技术		近三年不再出现的技术		变化显著的技术	
B23D	[2]	C23F	[15]	H01L	[-1]
F16S	[2]	D21H	[13]	B29C	[-1]
B06B	[1]	F21V	[1]	G02B	[-1]
B61F	[1]	B60R	[6]	C09J	[-.999]
B02C	[1]	B26F	[5]	G03G	[-.999]
A43B	[1]	B64G	[5]	G11B	[-.999]
B21C	[1]	F16K	[5]	D01D	[.996]
B60J	[1]	H01K	[5]	B29K	[-.993]
D07B	[1]	F16H	[4]	B29L	[-.987]
B21J	[1]	B24C	[4]	B41M	[.983]
E04C	[1]	C02F	[4]	H02K	[.976]
E04D	[1]	C10L	[4]	D03D	[.974]
B21K	[1]	H01P	[4]	C23F	[-.972]
B65C	[1]	B65B	[3]	D01F	[.968]
A63B	[1]	F16B	[3]	A41D	[.967]
G10D	[1]	F21W	[3]	C07F	[.961]
C12N	[1]	F21Y	[3]	D21H	[-.954]
B28D	[1]	C01G	[3]	A61M	[-.95]
A42B	[1]	G11C	[3]	C04B	[-.95]
		B30B	[3]	B41F	[.944]
		H02G	[2]	H01F	[.942]
		C23G	[2]	B05C	[-.935]
		C30B	[2]	D04H	[.933]
		C22B	[2]	C01B	[.929]
		B21B	[2]	F21V	[-.927]
		D05B	[2]	B23D	[.917]
		F16F	[2]	B41L	[.917]
		G21C	[2]	B64D	[.917]
		F02F	[2]	E21B	[.917]
		B23B	[2]	F16S	[.917]
		F03G	[2]	B29B	[.913]
		A62C	[2]	B08B	[.908]
		B27N	[2]		
		F02P	[2]		
		H04B	[2]		
		B26D	[2]		
		G01M	[2]		
		F17C	[2]		
		C07M	[2]		
		A47L	[2]		
		F02K	[1]		
		F02D	[1]		
		F24C	[1]		
		A21C	[1]		
		A01J	[1]		
		H04L	[1]		
		B25J	[1]		
		B62M	[1]		
		B22D	[1]		
		H05F	[1]		
		C09G	[1]		
		G21G	[1]		

	B60Q	[1]		
	D06J	[1]		
	A61Q	[1]		
	A23L	[1]		
	F25B	[1]		
	F24F	[1]		
	F28D	[1]		
	E01F	[1]		
	F42B	[1]		
	D06L	[1]		
	G01S	[1]		
	B31D	[1]		
	D21D	[1]		
	H02H	[1]		
	B66C	[1]		
	G05D	[1]		
	D06P	[1]		
	B03C	[1]		
	C07H	[1]		
	F02B	[1]		
	G05F	[1]		
	B61B	[1]		
	G21F	[1]		
	G05B	[1]		
	F01N	[1]		
	A45D	[1]		
	A01K	[1]		
	F01L	[1]		
	F01B	[1]		
	B60T	[1]		
	G03D	[1]		
	B09C	[1]		
	G10K	[1]		
	F25D	[1]		
	H03K	[1]		
	C25F	[1]		
	A47H	[1]		
	F01M	[1]		
	G10H	[1]		
	G10G	[1]		

## 四、小结

本报告以德温特公司与美国科学情报研究所（ISI）合作开发的基于 ISI 统一检索平台的网络版专利数据库 DII 为数据源基础。对 2001-2010 年间 DII 中收录的聚酰亚胺相关专利情况进行了统计与分析。

目的在于为了解聚酰亚胺技术的发展概况，提供一定参考。

如有纰漏，请指正。

## 附录一 IPC 分类号与技术领域对照表

IPC 分类号	对应的技术领域
C08G	用碳—碳不饱和键以外的反应得到的高分子化合物
C08L	高分子化合物的组合物
C08J	加工;配料的一般工艺过程;不包括在 C08B, C08C, C08F, C08G 或 C08H 小类中的后处理
C08K	使用无机物或非高分子有机物作为配料
B32B	层状产品, 即由扁平的或非扁平的薄层, 例如泡沫状的、蜂窝状的薄层构成的产品
H01B	电缆;导体;绝缘体;导电、绝缘或介电材料的选择
H01L	半导体器件;其他类目未包含的电固体器件
H05K	印刷电路;电设备的外壳或结构零部件;电气元件组件的制造
B29C	塑料的成型或连接;塑性状态物质的一般成型;已成型产品的后处理, 如修整
G03F	图文面的照相制版工艺, 例如, 印刷工艺、半导体器件的加工工艺;其所用材料;其所用原版;其所用专用设备
C09J	黏合剂;一般黏合方法;其他类目不包括的黏合方法;黏合剂材料的应用
G03F	图文面的照相制版工艺, 例如, 印刷工艺、半导体器件的加工工艺;其所用材料;其所用原版;其所用专用设备
H01B	电缆;导体;绝缘体;导电、绝缘或介电材料的选择
G02B	光学元件、系统或仪器
C09D	涂料组合物, 例如色漆、清漆、天然漆;填充浆料;化学涂料或油墨的去除剂;油墨;改正液;木材着色剂;用于着色或印刷的浆料或固体;原料为此的应用
C09K	不包含在其他类目中的各种应用材料;不包含在其他类目中的材料的各种应用
B23D	25/14 坯料不沿切割方向移动, 对剪切后的材料尺寸无要求的机械或装置, 如用于切断碎屑
F16S	一般结构元件;用这类元件组成的一般构件
C23F	非机械方法去除表面上的金属材料;金属材料的缓蚀;一般防积垢;至少一种在 C23 大类中所列的方法及至少一种在 C21D、C22F 小类或者 C25 大类中所列的方法之多步法金属材料表面处理
D21H	浆料或纸浆组合物;不包括在小类 D21C、D21D 中的纸浆组合物的制备;纸的浸渍或涂布;不包括在大类 B31 或小类 D21G 中的成品纸的加工;其他类不包括的纸
B06B	一般的机械振动的发生或传递
B61F	铁路车辆的悬架, 如底架、转向架、轮轴;在不同宽度的轨道上使用的铁路车辆;预防脱轨;护轮罩;障碍物清除器或类似装置
B02C	一般破碎、研磨或粉碎;碾磨谷物
A43B	鞋类的特征;鞋类的部件
B21C	用非轧制的方式生产金属板、线、棒、管或型材;与基本无切削金属加工有关的辅助加工
B60J	车辆的窗、挡风玻璃、非固定车顶、门或类似装置;专门适用于车辆的可移动的外部护套



D07B	一般的绳或缆
B21J	锻造;锤击;压制;铆接;锻造炉
E04C	结构构件;建筑材料
E04D	屋面覆盖层;天窗;檐槽;屋面施工工具
B21K	锻件或压制件的制造, 如马蹄铁、铆钉、螺栓、轮子
B65C	贴标签或签条的机械、装置或方法
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## 附录二 高被引专利列表

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Record 1 of 10

Patent Number(s): WO200180287-A; WO200180287-A2; US2002019081-A1; AU200153575-A; EP1275156-A2; KR2002089479-A; JP2003531487-W; CN1441967-A; US6825068-B2; US2005067656-A1; CN1237623-C; US7365394-B2; KR767233-B1; EP1275156-B1; DE60139463-E

Title: Fabrication of transistor(s) e.g., thin film transistor used in electrophoretic display by utilizing substrate containing polyphenylene polyimide

Inventor Name(s): DENIS K L; CHEN Y; DRZAIC P S; JACOBSON J M; KAZLAS P T; YU C; DENIS K; DRZAIC P; JACOBSON J; KAZLAS P

Patent Assignee(s): E-INK CORP (EINK-Non-standard); DENIS K L (DENI-Individual); CHEN Y (CHEN-Individual); DRZAIC P S (DRZA-Individual); JACOBSON J M (JACO-Individual); KAZLAS P T (KAZL-Individual)

Abstract: NOVELTY - Transistor(s) is fabricated by depositing layer(s) (24, 26) of semiconductor material on a substrate (12). The substrate comprises polyphenylene polyimide.

USE - The process is used for fabricating thin film transistor used in electrophoretic displays. It is useful to roll-to-roll operation and to fabricate large area transistor arrays on flexible substrates.

ADVANTAGE - The process allows the use of higher processing temperature and produces semiconductor layers of higher quality than prior art processes. The use of substrate containing polyphenylene polyimide reduces the risk of cracking and/or delamination of the semiconductor layer.

DESCRIPTION OF DRAWING(S) - The figure is a schematic cross-sectional view of the transistor.

Substrate (12)

Metal layer (14)

Passivating layer (18)

Layers of semiconductor material (24, 26)

Technology Focus/Extension Abstract: TECHNOLOGY FOCUS - ELECTRONICS - Preferred Process: A passivating layer (18) is deposited on surface(s) of the substrate before the deposition of

semiconductor material. The substrate is heated (i) at greater than 150 degreesC for at least 1 minute before the deposition of passivating layer, (ii) at greater than 250 degreesC for at least 5 hours after the deposition of passivating layer, and (iii) at greater than 250 degreesC for at least 1 hour before the deposition of semiconductor material. The deposition of semiconductor material is performed at greater 300 degreesC on a continuous web of substrate.

TECHNOLOGY FOCUS - INORGANIC CHEMISTRY - Preferred Components: The substrate comprises metal layer (14) having apertures on the side remote from the semiconductor material. The semiconductor material comprises amorphous silicon which is not patterned so that the amorphous silicon extends between the pairs of adjacent transistors. The passivating layer has a thickness of 20-100 nm and comprises silicon dioxide and/or aluminum nitride.

TECHNOLOGY FOCUS - POLYMERS - Preferred Compound: The polyphenylene polyimide is a derivative of biphenyl-3,3',4,4'-tetracarboxylic acid. The polyimide is a derivative of biphenyl-3,3',4,4'-tetracarboxylic acid and alpha,omega-alkanediamine.

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Record 2 of 10

Patent Number(s): US2001030549-A1; US6860009-B2

Title: Probe membrane construction for integrated circuit testing, involves patterning polyimide layer around depressions which are created within substrate

Inventor Name(s): GLEASON R; BAYNE M A; SMITH K; LESHER T; KOXXY M

Patent Assignee(s): GLEASON R (GLEA-Individual); BAYNE M A (BAYN-Individual); SMITH K (SMIT-Individual); LESHER T (LESH-Individual); KOXXY M (KOXX-Individual); CASCADE MICROTECH INC (CASC-Non-standard)

Abstract: NOVELTY - Several depressions (216) are created within a substrate. A polyimide layer (220) is patterned around the depressions and a conductive trace is connected to the polyimide layer, after which the substrate is removed from the polyimide layer.

USE - For constructing probe assemblies for testing integrated circuits.

ADVANTAGE - The construction technique is relatively quick due to decreased number of processing steps. Hence, reduces the construction cost. The small movement of the lower surface of the device makes good electrical contact during testing, hence decreases the stress on the layers under the lower surface of the device. Thereby, reducing cracking of the polyimide layers and the conductive traces.

DESCRIPTION OF DRAWING(S) - The drawing shows a sectional view of the substrate.

depression (216)

polyimide layer (220)

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Record 3 of 10

Patent Number(s): WO200106646-A; EP1196989-A; US6788170-A; WO200106646-A1; AU200062844-A; EP1196989-A1; CN1361939-A; JP2003505905-W; US6788170-B1; JP3740061-B2; CN1201486-C; EP1196989-B1; DE60042486-E

Title: Resonator structure for RF filter used in mobile phone, has polyimide material layer that is formed in peripheral region enclosing center region of piezoelectrically excitable area

Inventor Name(s): KAITILA J; YLILAMMI M; ELLAE J; KAITILA J A; ELL J

Patent Assignee(s): NOKIA MOBILE PHONES LTD (OYNO); NOKIA CORP (OYNO); AVAGO TECHNOLOGIES WIRELESS IP SINGAPORE (AVAG)

Abstract: NOVELTY - The piezoelectric layer is formed in between the conductor layers that are extended in piezoelectrically excitable area. The polyimide material layer is formed in peripheral region that encloses the center region of piezoelectrically excitable area. Piezoelectric vibrations are dampened effectively in peripheral region.

USE - For RF filter used in mobile phone.

ADVANTAGE - Improves response of resonator structure that is easy to manufacture. Reduces higher order lateral frequency modes by dampening at edge of excitable area.

DETAILED DESCRIPTION - An INDEPENDENT CLAIM is also included for filter having resonator structure.

DESCRIPTION OF DRAWING(S) - The figure shows the calculated response of resonator structure.

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Record 4 of 10

Patent Number(s): US6391932-B1

Title: Preparation of porous polyimide dielectric materials for electronic components, involves subjecting cured polyimide dielectric matrix material film to conditions which remove porogen soluble in uncured matrix material

Inventor Name(s): GORE R H; GALLAGHER M K; IBBITSON S A

Patent Assignee(s): SHIPLEY CO LLC (SHIL)

Abstract: NOVELTY - Crosslinked polymeric porogen particles are dispersed in an uncured (B-staged) polyimide dielectric material to form B-staged polyimide dielectric matrix material. A film of the material is formed, cured and subjected to conditions which partially remove porogens. The porogen particles are soluble in B-staged material, and comprise monomer capable of hydrogen-bonding with the material, as polymerized units.

USE - Useful in electronic component manufacture to produce integrated circuits (claimed), printed wiring boards, wireless devices and optoelectronic devices. The porous dielectric material, as thin films, is useful as insulator, anti-reflective coating, sound barrier, thermal breaks, and optical coating.

The porous polyimide dielectric material is also used in the fabrication of multi-level integrated circuits, e.g., microprocessors, digital signal processors, memory chips and band pass filters.

ADVANTAGE - The method provides porous polyimide dielectric matrix material having greater percentage of pores by volume, more uniformly dispersed pores and low dielectric constant. The porous polyimide dielectric material is suitable for use in any application where a low refractive index or low dielectric constant material is used. The material is also suitable for use on a variety of substrates such as gallium arsenide, silicon-germanium, silicon-on-insulator, silicon, alumina, aluminum-nitride, printed wiring board, flexible circuit, multi-chip module, flip chip, copper, high and low dielectric materials, resistors and barrier layers.

DETAILED DESCRIPTION - INDEPENDENT CLAIMS are included for the following:

(1) Porous polyimide dielectric material;

(2) Preparation of integrated circuit which involves depositing on a substrate, a layer of a composition comprising B-staged polyimide dielectric matrix material having cross-linked polymeric porogen particles dispersed, subjecting cured matrix material to conditions which at least partially remove the porogen particles to form a porous polyimide dielectric material layer, patterning the formed layer, depositing a metallic film onto the patterned layer, and planarizing a metallic film to form an integrated circuit; and

(3) Composition comprising a B-staged polyimide dielectric matrix material and cross-linked polymeric porogen particles.

Technology Focus/Extension Abstract: TECHNOLOGY FOCUS - ORGANIC CHEMISTRY - Preferred Monomers: The monomer capable of hydrogen-bonding with the B-staged polyimide dielectric matrix material is hydroxylalkyl (meth)acrylate, hydroxystyrene, primary-, secondary-, or tertiary-aminoalkyl (meth)acrylate and/or (meth)acrylic acid. Preferred Dianhydride: The polyimide dielectric material comprises aromatic tetracarboxylic acid dianhydride(s) and aromatic diamine(s). The aromatic tetracarboxylic acid dianhydride is of formula (I). A = tetrasubstituted 6-20C aromatic group, preferably a pyromellitic group, a polycyclic aromatic group such as naphthylene, a fluorenylene, a benzofluorenylene, an anthracenylylene and halo- 1-10C alkyl- or 1-10C haloalkyl-substituted derivatives and moieties of formula (II). B = bond, C(R)<sub>2</sub>, CO, O, S, SO<sub>2</sub>, Si(C<sub>2</sub>H<sub>5</sub>)<sub>2</sub> and/or N(R')<sub>2</sub>; m = 1-10; R = H or C(R<sub>2</sub>)<sub>3</sub>; R' = H, 1-20C alkyl, 1-20C haloalkyl, 6-20C aryl or 6-20C haloaryl; and R<sub>2</sub> = H, fluorine or chlorine. The dianhydride is preferably chosen from 27 claimed compounds, such as pyromellitic dianhydride and 3,6-diphenylpyromellitic dianhydride. Preferred Diamine: The aromatic diamine is of formula (III) or (IV). H<sub>2</sub>N-Ar-NH<sub>2</sub> (III) H<sub>2</sub>N-Ar-L-Ar-NH<sub>2</sub> (IV) Ar = aryl group chosen from phenylene, naphthylene, anthrylene, phenanthrylene, heterocyclic groups having at least one of sulfur, nitrogen or oxygen in heterocyclic ring; L = linking group chosen from covalent bond, SO<sub>2</sub>, (CR<sub>3</sub>R<sub>4</sub>)<sub>n</sub>, aryl, O and S; R<sub>3</sub> and R<sub>4</sub> = H, 1-6C alkyl, halo (1-6C) alkyl and aryl; and n = 1-10. The diamine is preferably chosen from 43 claimed compounds such as 2-methyl (p-phenylenediamine) and 2,5-dimethyl(p-phenylenediamine).

TECHNOLOGY FOCUS - POLYMERS - Preferred Porogen: The porogen comprises as polymerized units one or more polymers chosen from styrene (STY)/allyl methacrylate (ALMA), 2-ethyl hexyl acrylate (EHA)/STY/ALMA, benzylacrylate (BzA)/divinyl benzene, BzA/trimethylolpropane trimethacrylate (TMPTMA), methyl methacrylate (MMA)/ALMA, EHA/TMPTMA, 2-ethylhexyl methacrylate (EHMA)/TMPTMA, 2-hydroxyethyl methacrylate (HEMA)/STY/ALMA, HEMA/STY/TMPTMA, HEMA/ALMA, MMA/HEMA/ALMA, poly(propylene glycol) methyletheracrylate having a molecular weight of about 260 (PPGMEA260)/HEMA/trimethylolpropane triacrylate (TMPTA) or PPGMEA260/dimethylaminoethyl methacrylate (EMAEMA)/TMPTA.

EXAMPLE - Porogens compatible with polyimide dielectric matrix material was prepared using the monomer composition of poly(propyleneglycol) methyletheracrylate having a molecular weight of about 260, 2-hydroxyethyl methacrylate and trimethylol propane triacrylate in the ratio of 10/80/10. The compatibility of the prepared porogen sample in B-staged aromatic polyimide dielectric matrix material in N-methyl pyrrolidinone was determined. The B-staged polyimide material was Pyralin PI-2808. The porogen was substantially compatible with polyimide dielectric matrix material and the film compatibility was also good.

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Record 5 of 10

Patent Number(s): US6565928-B1; JP2000323471-A; US6284044-B1; US2001041229-A1; US6565928-B2

Title: Polyimide film forming method for semiconductor device manufacture, involves solidifying film on peripheral edge portion of wafer, after removing film formed on circumferential portion of wafer

Inventor Name(s): SAKAMOTO Y; YAEGASHI H

Patent Assignee(s): TOKYO ELECTRON LTD (TKEL); SAKAMOTO Y (SAKA-Individual); YAEGASHI H (YAEG-Individual)

Abstract: NOVELTY - The polyimide liquid is supplied on wafer (W) to form polyimide film (P) of predetermined thickness on its surface. Then, the film formed on circumferential portion of wafer is removed by supplying clean liquid and irradiating the surface using laser beam. After which, film on the edge of peripheral portion of wafer is solidified.

USE - For semiconductor device manufacture.

ADVANTAGE - Prevents drying of process liquid in center portion of wafer, and flow of liquid into the circumference part of wafer, even when wafer is moved.

DETAILED DESCRIPTION - An INDEPENDENT CLAIM is also included for polyimide film forming apparatus.

DESCRIPTION OF DRAWING(S) - The figure shows the sketchy explanatory diagram of film forming apparatus.

Wafer (W)

Polyimide film (P)

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Record 6 of 10

Patent Number(s): WO200109948-A; EP1198835-A; WO200109948-A1; AU200067546-A; US6287940-B1; EP1198835-A1; KR2002020954-A; CN1377512-A; JP2003506871-W; KR704249-B1; IN200200147-P1; CA2381081-C

Title: Wafer attachment process used for forming bolometer involves forming two wafers with connections on surfaces, bonding wafer surfaces with polyimide layers, etching holes through polyimide layers and sputtering conductive material into holes

Inventor Name(s): COLE B E; RIDLEY J A; HIGASHI R E

Patent Assignee(s): HONEYWELL INC (HONE); HONEYWELL INT INC (HONE)

Abstract: NOVELTY - Dual wafer attachment process involves forming two wafers having connections on their surfaces, applying polyimide layers on the wafers, bonding the wafers through the two polyimide layers under pressure and heat, etching holes through the polyimide layers down to sets of respective connections and sputtering a conductive material into the holes so as to make contact to the sets of connections.

USE - The process can be used for bonding a wafer having high temperature thermal sensor on its surface to a wafer having low temperature complementary metal oxide semiconductor (CMOS) electronics on its surface. The process is used for forming a bolometer.

ADVANTAGE - The process provides a good method for bonding a microstructure with a single or multilayer material which is crystalline or amorphous, while incorporating the materials having a temperature coefficient of resistance that range from a typical value of 2%/C to a high value of 3.5%/C on the wafers. The temperature coefficient of resistance (TCR) may be measured at a value of 12%/C on bulk substrates with much lower  $1/f$  ( $k = 10$  to the power  $-14$ ) noise than VOx (vanadium oxide) ( $k = 10$  to the power  $-13$ ) films. The material may be thinned after wafer removal to improve performance with lower mass.

DETAILED DESCRIPTION - Process for attaching first and second wafers, at least one wafer having a microstructure comprises:

- (a) making a first wafer having low-temperature microelectronics, having a first set of connections;
- (b) making a second wafer at a high temperature having a second set of connections mirrored to match the first set of connections;
- (c) applying polyimide layers on the topsides of the first and second wafers;
- (d) soft baking the wafers;
- (e) facing the topsides of the wafers with each other;
- (f) aligning the wafers to each other;
- (g) bonding the wafers together under a pressure at a temperature in a non-oxidizing environment;
- (h) etching holes through the polyimide layers down to sets of respective connections; and
- (i) sputtering a conductive material into the holes so as to make contact to the sets of connections.

Patent Number(s): US6213995-B1

Title: Flexible tube for use as medical electrode catheter comprises inner and outer wall layers comprising polyimide matrix, with inner layer containing number of braid elements

Inventor Name(s): STEEN B; DANIEL S

Patent Assignee(s): PHELPS DODGE HIGH PERFORMANCE CONDUCTORS (PHEL)

Abstract: NOVELTY - The flexible tube comprises inner wall layer (12) defining lumen (13) and outer wall layer (32), with both layers made of polyimide matrix. Inner wall has number of braid elements (BE) (14) forming a braid (16) over length of inner wall. BE includes at least two signal transmitting elements (STE) (18) and at least one non-conductive element having strength greater than STE.

USE - For use as medical electrode catheter used to electrically stimulate and/or monitor the heart and to modify the heart tissue.

ADVANTAGE - The flexible tubing has the capacity of transmitting signals along its length and also has desirable structural properties. The structural elements provide a degree of torsional stiffness, kink resistance, luminal rigidity, tensile and compressive strength, hoop strength and scrap resistance to the catheter.

DETAILED DESCRIPTION - Each of STE is individually coated and criss-crossed with each other within braid.

DESCRIPTION OF DRAWING(S) - The figure shows partially cut-away perspective view of flexible tubing.

Inner wall layer (12)

Lumen (13)

Braid elements (14)

Braid (16)

Signal transmitting elements (18)

Outer wall layer (32)

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Record 8 of 10

Patent Number(s): US6256882-B1

Title: Membrane probe constructing method for integrated circuit testing, involves forming polyimide layer over conductive material formed in depression of substrate, after which the substrate is removed

Inventor Name(s): GLEASON R; BAYNE M A; SMITH K; LESHER T; KOXXY M

Patent Assignee(s): CASCADE MICROTECH INC (CASC-Non-standard)

Abstract: NOVELTY - Conductive material made of nickel and rhodium is deposited in the depression formed in a substrate. A polyimide layer is formed over the material after connecting the conducting material with trace. After completion of the polyimide layer formation, the substrate is removed from the material.

USE - For testing integrated circuit.

ADVANTAGE - Quickens construction of probe, because of decreased number of processing steps, thus cost is saved.

DESCRIPTION OF DRAWING(S) - The figure shows the pictorial view of dimpling tool.

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Record 9 of 10

Patent Number(s): US2003213580-A1; US6827128-B2

Title: Flexible microchannel heat exchanger for, e.g. laptop computer cooling, includes channel layer formed from heat-sealable polyimide material and having fluid flow microchannels connected with fluid distribution channels of header layer

Inventor Name(s): PHILPOTT M I; SHANNON M A; SELBY J C

Patent Assignee(s): UNIV ILLINOIS (UNII); UNIV ILLINOIS FOUND (UNII)

Abstract: NOVELTY - A flexible microchannel heat exchanger includes a header layer formed from heat-sealable polyimide material and having fluid distribution microchannels and a channel layer formed from heat-sealable polyimide and heat-sealed to a header layer. The channel layer includes a fluid flow microchannels connected with the fluid distribution channels and oriented differently than the fluid distribution channels.

USE - For laptop computer cooling, car seat heating and cooling, or compact heat exchangers.

ADVANTAGE - The fluid flow microchannels are aligned in multiple orientation and permit use of flexible material without sagging the channel and provides uniform fluid flows.

DETAILED DESCRIPTION - A flexible microchannel heat exchanger comprises a device interface layer having inlet and outlet holes (26, 28) and formed from a first heat-sealable polyimide material and a header layer formed from a second heat-sealable polyimide material and heat-sealed to the device interface layer. The header layer has ports (30) aligned with the inlet and outlet holes and fluid distribution microchannels (24) connected with the ports. A channel layer formed from the second heat-sealable polyimide material is heat-sealed to the header layer. It has fluid flow microchannels connected with the fluid distribution channels and oriented differently than the fluid distribution channels. A cap layer formed from the first heat-sealable polyimide material and heat sealed to the channel layer. An INDEPENDENT CLAIM is also included for a method for forming a flexible microchannel heat exchanger comprising mechanically patterning heat-sealable polyimide sheets to define separate device interface, header, channel layers; preparing the patterned sheets for lamination bonding; and laminating the patterned sheets together with a cap layer.



DESCRIPTION OF DRAWING(S) - The figure is an exploded schematic view of mesoscopic heat exchanger.

Microchannels (24)

Holes (26, 28)

Ports (30)

Waist (31)

Set of microchannels (36, 38)

Technology Focus/Extension Abstract: TECHNOLOGY FOCUS - MECHANICAL ENGINEERING - Preferred Component: The microchannels in the channel layer have an overall hourglass-like shape whose waist (31) aligns with the ports in the header layer. The connection between microchannels in the header layer and the channel layer is where ends of microchannels in the channel layer intersect microchannels in the header layer. The microchannels or sets of microchannels (36, 38) in the channel layer, which are far from the ports intersect more microchannels in the header layer than microchannels or sets of microchannels in the channel layer that are closer to the ports. Preferred Parameter: The microchannels in the channel layer have a plurality of lengths. The header and channel layers are thicker than the device interface and cap layers. Preferred Method: The method includes cutting the heat-sealable polyimide sheet and mounting the sheets on a carrier before the patterning step, and applying a platen separator to the cap layer and the device interlayer prior to the lamination step. The cutting step is performed by a computer controlled knife cutting conducted according to a three-dimensional solid model. The preparing step involves solvent degreasing, scrubbing, rinsing, drying and dehydrating.

TECHNOLOGY FOCUS - POLYMERS - Preferred Property: The first heat-sealable polyimide material has a greater glass transition temperature than the second heat-sealable polyimide material. It has a core having the greater glass transition temperature. Preferred Material: The first and second heat-sealable polyimide materials are Kaptona EKJ and Kaptona KJ DuPont, respectively.

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Record 10 of 10

Patent Number(s): EP1311038-A3; EP1311038-A2; US2003092320-A1; CA2406428-A1; JP2003187920-A; CN1419320-A; KR2003040078-A; US6848944-B2; US2005118869-A1; EP1311038-B1; DE60213053-E; DE60213053-T2; CN1305179-C; US7310875-B2; TW566681-U

Title: Electrical connector for high-speed communication, has phosphor bronze ground plane plated and etched on planar polyimide dielectric

Inventor Name(s): EVANS R F; EVINS R F; EVANS R F, US

Patent Assignee(s): FCI (FRAT); EVANS R F (EVAN-Individual); FCI AMERICAS TECHNOLOGY INC (FRAT); FCI FRAMATOME CONNECTORS INT (FRAT); FCI FRANCE CHIRURGIE INSTR SA (ZEIS)

Abstract: NOVELTY - A phosphor bronze ground plane is plated and etched on planar polyimide dielectric. A signal conductor is positioned on opposing planar surface of the dielectric.

USE - For high-speed communication, for establishing signal connections between electronic devices.

ADVANTAGE - The electronic devices having mating surfaces orthogonal to each other are connected easily with improved reliability. The electrical connectors are manufactured easily at reduced assembly time by plating and etching conductors on the dielectric, thereby eliminating overmolding time.

DETAILED DESCRIPTION - INDEPENDENT CLAIMS are also included for the following:

- (1) electrical interconnection system; and
- (2) electrical connector manufacturing method.

DESCRIPTION OF DRAWING(S) - The figure shows a perspective view of the electrical connector.

### 附录三 化学所专利列表

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Record 1 of 17

Patent Number(s): CN101343362-A

Title: New polyimide resin for metal foil laminated board used in packaging substrate of super-large scale integrated circuit

Inventor Name(s): FAN L; XU H; YANG H; YANG S

Patent Assignee(s): CHINESE ACAD SCI CHEM INST (CSCI)

Abstract: NOVELTY - A polyimide resin is new.

USE - Polyimide resin for metal foil laminated board (claimed) used in packaging substrate of super-large scale integrated circuit.

ADVANTAGE - The polyimide resin has excellent heat resistance, high mechanical property, low dielectric constant and loss, high electric insulation property and low hygroscopic property.

DETAILED DESCRIPTION - A polyimide resin of formula (II) is new.

R=one or more of 7 benzene containing compounds, e.g. compounds of formulae (1-5);

X1, X2=dianhydride group;

Ar'=one or more of 21 benzene containing compounds, e.g. compounds of formulae (1-5);

T=end-capping agent containing end-capping group including aniline, phthalic anhydride, 4-phenylacetylene phthalic anhydride, 4-phenylacetylene aniline or 5-norbornene-2,3-dicarboxylic acid anhydride; and

m, n=1-100.

INDEPENDENT CLAIMS are included for:

(1) method for preparing the polyimide resin;

(2) a polyamic acid formula (I);

(3) a method for preparing the polyamic acid comprising adding the tetrabasic acid dianhydride monomer and the end-capping agent into the organic solution of diamine monomer to obtain the polyamic acid after the reaction;

(4) a metal foil laminated board comprising the polyimide resin, fiber reinforced material and metal foil layer; and

(5) a method for preparing the metal foil laminated board comprising dipping the fiber reinforced material in the organic solution of the polyamic acid and raising temperature, when the temperature is 80-200 degrees C, the temperature is raised at 40 degrees C for 0.1-2.5 hours, and keeping the temperature for 0.1-2 hours when the temperature is raised to 250 degrees C, and then obtaining the prepreg after the reaction; laminating the prepreg, and covering the metal foil layer at one side or two sides of the prepreg to obtain the metal foil laminated board after heat pressing.

Technology Focus/Extension Abstract: TECHNOLOGY FOCUS - CERAMICS AND GLASS - Preferred Material: The fiber reinforced material is E-type glass fiber cloth.

TECHNOLOGY FOCUS - METALLURGY - Preferred Material: The metal foil layer is copper foil layer, aluminum foil layer, silver foil layer or copper-nickel alloy foil layer.

TECHNOLOGY FOCUS - ORGANIC CHEMISTRY - Preparation (Claimed): The polyimide resin is prepared by adding catalyst and dehydrating agent into the polyamic acid solution to obtain the polyimide resin after the reaction, where the catalyst is pyridine, fatty amine, hydroxypyridine, aminopyridine and/or p-toluene sulfonic acid, and the dehydrating agent is acetic anhydride, glacial acetic acid, thionyl chloride, trifluoroacetic anhydride, benzoic anhydride, propionic anhydride and/or butyric anhydride. Preferred Component: The tetrabasic acid dianhydride monomer is 3,3',4,4'-diphenyl ketone tetrabasic acid dianhydride, 4,4'-oxyphthalic anhydride, 3,3',4,4'-diphenylsulfone tetrabasic acid dianhydride, 2,2-bis(3',4'-dicarboxylic acid phenyl)hexafluoropropane dianhydride, trifluoromethyl phenyl-1,1'-bis(3',4'-dicarboxylic acid phenyl)methane dianhydride, 3,3',4,4'-diphenyl tetrabasic acid dianhydride, 2,3,3',4'-diphenyl tetrabasic acid dianhydride, 4,4'-bis(dicarboxylic acid phenoxy)phenylene dianhydride or 2,2-bis(4-(3,4-dicarboxylic acid phenoxy)phenyl)-propane dianhydride. The diamine monomer is 1,4-bis(4'-amino-2'-trifluoromethyl phenoxy)benzene, 1,3-bis(4'-amino-2'-trifluoromethyl phenoxy)benzene, 4,4'-bis(4-amido-2-trifluoromethyl phenoxy)diphenyl, 4,4'-bis(3-amido-5-trifluoromethyl phenoxy)diphenyl, 2-(p-trifluoromethyl phenyl)-1,4-bis(4'-amino-2'-trifluoromethyl phenoxy)benzene, 2-(m-trifluoromethyl phenyl)-1,4-bis(4'-amino-2'-trifluoromethyl phenoxy)benzene, 3,3',5,5'-tetramethyl-4,4'-bis(4-amido-2-trifluoromethyl phenoxy)diphenyl, 2,6-bitertiary butyl-1,4-bis(4'-amino-2'-trifluoromethyl phenoxy)benzene, p-phenylene diamine, m-phenylene diamine, 4,4'-oxydiphenylamine, 3,4'-oxydiphenylamine, 4,4'-diamine diphenylmethane, 4,4'-diamino diphenyl, 2,2-bis(4-(amino phenoxy)phenyl)sulfone, 4,4-bis(4-amino phenoxy)benzophenone, 1,3-bis(3-amino phenoxy)benzene, 1,3-bis(4-amino phenoxy) benzene, 1,4-bis(4-amino phenoxy)benzene, 2,2-trifluoromethyl-4,4-diamine diphenyl, 4,4'-di(4-amino phenoxy)phenoxy or 2,2-bis(4-amino phenyl)hexafluoropropane. The weight ratio of the tetrabasic acid dianhydride, the diamine monomer and the end-capping agent is 100:20-500:0-40. The end-capping agent is aniline, phthalic anhydride, 4-phenylacetylene phthalic anhydride, 4-phenylacetylene aniline or 5-norbornene-2,3-dicarboxylic acid anhydride. In the organic solution of diamine monomer, the organic solvent is random proportion of N-methyl-2-ketopyrrolidine, metacresol, N,N-dimethyl acetamide and/or N,N-

dimethyl formamide. The catalyst is pyridine and/or trimethylamine. The dehydrating agent is acetic anhydride. The polyamic acid solution is 10-30 mass%. The mass ratio of polyamic acid solution, catalyst and dehydrating agent is 100:20-90:10-90. In the polyamic acid solution, the solvent is N-methyl-2-ketopyrrolidine, metacresol, N,N-dimethyl acetamide and/or N,N-dimethyl formamide. Toluene and isoquinoline are added into the polyamic acid solution to obtain the polyimide resin after the reaction at 150-200 degrees C for 4-24 hours. The mass ratio of polyamic acid solution, toluene and isoquinoline is 100:20-20:0.01-0.5. Preferred Method: The method comprises coating the polyamic acid on the flat slab uniformly and then raising temperature. When the reaction is at 80-200 degrees C, the temperature is raised to 40 degrees C for greater than or equal to 0.1-2.5 hours, and keeping the temperature for 0.1-2 hours when the temperature is raised to 250 degrees C, and then obtaining the polyimide resin after the reaction. Preferred Condition: In the preparation of polyamic acid, the reaction is carried out at 20-50 degrees C for 0.5-25 hours. In the preparation of polyimide resin, the reaction is carried out at 5-70, preferably 10-60 degrees C for 1-25, preferably 2-20 hours. The heat pressing is carried out at 260-360 degrees C and 1-6 MPa for 10-60 minutes.

TECHNOLOGY FOCUS - POLYMERS - Preferred Component: The mass ratio of polyimide resin and fiber reinforced material is 30-60:40-65. Preferred Property: The polyimide resin has a number average molecular weight of 10000-80000, preferably 15000-60000, and viscosity of 0.5-1.2 dl/g.

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Record 2 of 17

Patent Number(s): CN1676548-A; CN1320060-C

Title: Short-fiber reinforced polyimide composite material, and its preparing method and use

Inventor Name(s): YANG S; CHEN J; FAN L

Patent Assignee(s): CHINESE ACAD SCI CHEM INST (CSCI)

Abstract: NOVELTY - This invention disclose a staple fiber reinforcing PI compound material, which comprises 1) staple fiber comprises carbon fiber, graphite fiber, glass fiber, quartz fiber, Kevlar fiber and its mixture of any proportion; 2) functional additive includes graphite powder, molybdenum disulfide powder, PTFE powder, bronze powder, Al powder, FeO<sub>2</sub> powder, silica, inorganic whiskers, mould discharging agent, carbon powder and its mixture of any proportions; and 3) PI under 1-10MPa pressure through heat solidification technique (less than 350deg.C). The compound of this invention has high heat endurance, good mechanic performance, wearing endurance and self-lubrication. It can be wide used in the fields of electric mechanism, mine mechanism, spin mechanism, chemical mechanism, medical mechanism and automobile mechanism and aviation mechanism.

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Record 3 of 17

Patent Number(s): CN101735116-A

Title: New sulfonated aromatic diamine used for preparing sulfonated polyimide proton exchange film materials for fuel cells, preferably direct methanol fuel cells

Inventor Name(s): FAN L; SUN F; YANG S

Patent Assignee(s): CHINESE ACAD SCI CHEM INST (CHSC-Non-standard)

Abstract: NOVELTY - Sulfonated aromatic diamine (I) or (II), is new.

USE - Compound (I) is used for preparing sulfonated polyimide (II) resin, which is used for preparing proton exchange film materials (all claimed) for fuel cells, preferably direct methanol fuel cells.

ADVANTAGE - The compound is easy to prepare; has good solubility and film forming property, excellent thermal stability and lower methanol permeability; and makes film have good proton conduction characteristic.

DETAILED DESCRIPTION - Sulfonated aromatic diamine of formula (I) is new.

A, D, E, G, J = sulfonic radical or H;

R1 = O, S, -C(=O)-, or formulae (i)-(iii);

Ar'' = groups of formulae (iv)-(v);

Ar' = groups of formulae (vi)-(xiii);and

m:n = 0.5-8:1.

x = 1 or 2;and

y = 0 or 1.

Provided that A, D, E, G and J are not hydrogen at the same time. INDEPENDENT CLAIMS are included for:

(1) preparation of (I);

(2) sulfonated polyimide resin of formula (II); and

(3) preparation of (II).

Technology Focus/Extension Abstract: TECHNOLOGY FOCUS - ORGANIC CHEMISTRY - Preparation (claimed): Compound (I) is prepared by mixing (pts.wt.) trifluoroacetate compound (15-50), magnesium powder (10-30), substituted halobenzene (5-20) and tetrahydrofuran (200-500); stirring the mixture at room temperature for 1-4 hours; heating the mixture at 60-70 degrees C for 1-4 hours; cooling at room temperature; adding hydrochloric acid (10-30 wt.%); collecting formed organic phase; rectifying the organic phase; mixing (pts.wt.) rectification product (5-15), aniline (30-150) and an aniline salt (10-30); heating the mixture at 180-190 degrees C for 10-28 hours; cooling to room temperature; adding water (10-20 wt.%); distilling for 4-10 hours; washing obtained sediment; drying; recrystallizing using ethanol aqueous solution; dissolving obtained crystals in concentrated sulfuric acid having a concentration of 98% under the protection of ice-water bath; adding (pts.wt.) fuming sulfuric acid (30-100) and sulfur trioxide (10-50) to the reaction product (5-15); reacting at 0 degrees C for 0.5-2 hours; reacting at 40-100 degrees C for 5-20 hours; pouring ice water to obtain the solid sediment; filtering; dissolving obtained filter cake in water (10-20 wt.%); filtering; titrating the filtrate with diluted acid having a concentration of 10-30% to obtain the solid sediment; filtering; washing

separated filter cake; and drying. Compound (II) is prepared by dissolving (pts.wt.) non-sulfonated aromatic diamine (1-10) and triethylamine (2-30) in an organic solvent in the presence of inert gas; adding (pts.wt.) naphthaline-containing dianhydride (2-20) and phenylformic acid (2-30) as dehydration catalyst; heating the mixture at 80-120 degrees C for 4-8 hours; heating further at 160-200 degrees C for 12-48 hours; cooling; pouring acetone to obtain fibroid sediment; filtering; washing separated filter cake; filtering; and drying. Preferred Components: The trifluoroacetate compound is potassium trifluoroacetate, lithium trifluoroacetate, sodium trifluoroacetate, magnesium trifluoroacetate and/or aluminum trifluoroacetate. The substituted halobenzene is 4-fluorodiphenyl ether, 4-chlorodiphenyl ether, 4-bromodiphenyl ether, 4-fluorodiphenyl sulfide, 4-chlorodiphenyl sulfide, 4-bromodiphenyl sulfide, 4-fluorodiphenyl ketone, 4-chlorodiphenyl ketone, 4-bromodiphenyl ketone, 1-fluoro-(4'-(4''-phenoxy)-phenoxy)benzene, 1-chloro-(4'-(4''-phenoxy)-phenoxy)benzene, 1-bromo-(4'-(4''-phenoxy)-phenoxy)benzene, 1-fluoro-(4'-(4''-thiophenyl)thiophenyl)benzene, 1-chloro-(4'-(4''-thiophenyl)thiophenyl)benzene, 1-bromo-(4'-(4''-thiophenyl)thiophenyl)benzene, 4-fluorobiphenyl, 4-chlorobiphenyl, 4-bromobiphenyl, 1-phenylmethyl-4-fluorobenzene, 1-phenylmethyl-4-chlorobenzene or 1-phenylmethyl-4-bromobenzene. The aniline salt is formed by the reaction of aniline, and methane sulfonic acid, p-toluenesulfonic acid, trifluoromethanesulfonic acid, trifluoroacetic acid, hydrochloric acid or nitric acid. The non-sulfonated aromatic diamine is 1,4-di(4'-aminophenoxy)benzene, 4,4'-di(4'-aminophenoxy)biphenyl, 1,4-di(4'-amino-2'-trifluoromethylphenoxy)benzene, 4,4'-di(4'-amino-2'-trifluoromethylphenoxy)biphenyl, 2,2'-di(trifluoromethyl)-4,4'-diaminobiphenyl, 2,2'-hexafluoropropane-4,4'-diaminobenzene, 4,4'-diaminosulfobenzide and/or di(4-(3-aminophenoxy)phenyl)sulfone. The naphthaline-containing dianhydride is 1,4,5,8-naphthaline tetracarboxylic acid dianhydride and/or 4,4'-binaphthalin-1,1',8,8'-tetraacid dianhydride. The organic solvent is methyl phenol, N-methyl pyrrolidone or N,N-ammonium dimethylacetate.

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Record 4 of 17

Patent Number(s): CN101654518-A

Title: New polyimide resin for use in preparing polyimide resin-based composite material used for preparing high temperature resistant parts in fields of aviation, space flight and space technologies

Inventor Name(s): FAN L; JI M; QU X; YANG S

Patent Assignee(s): CHINESE ACAD SCI CHEM INST (CSCI)

Abstract: NOVELTY - A polyimide resin is new.

USE - A polyimide resin for use in preparing polyimide resin-based composite material (claimed) used for preparing high temperature resistant parts in fields of aviation, space flight and space technologies.

ADVANTAGE - The number-average molecular weight of polyimide resin is 1000-9000. The polyimide resin is processed by heat treatment to obtain resin molding powder having low melt viscosity and to obtain pure resin mold with high mechanical property and good heat resistance after heat treatment. The polyimide resin is suitable for dipping carbon fiber, glass fiber and aramid fiber to prepare pre-impregnated material having good shape processing performance. The composite material has low porosity, high mechanical property and good heat resistance, and can be used for long time at 350-370 degrees C.

DETAILED DESCRIPTION - A polyimide resin of formula (I) is new.

Ar<sup>1</sup>=one or more of 3 groups e.g. formula (a);

R1=one or more of 20 groups e.g. formula (b);

R2=-C(=O)-, -O- or -C(CF<sub>3</sub>)(CF<sub>3</sub>)-;

m=1-20;and

n=0.01-6.

An INDEPENDENT CLAIM is included for preparation of polyimide resin (I).

Technology Focus/Extension Abstract: TECHNOLOGY FOCUS - ORGANIC CHEMISTRY - Preferred Components: The organic fatty alcohol solvent comprises methanol, ethanol, propanol, isopropanol, n-butanol, isobutanol, n-amyl alcohol, iso-amyl alcohol and/or tert-butanol; or mixture of alcohol and acetone, tetrahydrofuran, dioxane, benzene, toluene, chloroform and/or dichloromethane. Preferred Composition: The weight ratio of end-capping agent to organic fatty alcohol solvent is 5-60:5-600. The weight ratio of aromatic tetracid dianhydride to organic fatty alcohol solvent is 100:60-1200. The weight ratio of aromatic diamine to organic fatty alcohol solvent is 30-150:10-800.

TECHNOLOGY FOCUS - POLYMERS - Preparation (claimed): The polyimide resin (I) is prepared by:(A) esterifying end-capping agent of formula (II) and organic fatty alcohol solvent to obtain end-capping agent-monoacid monoester solution;(B) esterifying aromatic tetracid dianhydride and organic fatty alcohol solvent to obtain aromatic tetracid diester solution; and(C) dissolving aromatic diamine in organic fatty alcohol solvent, and adding end-capping agent-monoacid monoester solution and aromatic tetracid diester solution to obtain polyimide resin solution.The aromatic tetracid dianhydride is mixture of two aromatic tetracid dianhydrides, where first aromatic tetracid dianhydride comprises one or more of 3 compounds e.g. formula (A1), and second aromatic tetracid dianhydride comprises one or more of 3 compounds e.g. formula (B1). The aromatic diamine comprises one or more of 20 compounds e.g. p-phenylenediamine, m-phenylenediamine, 4,4'-diaminobiphenyl or diamine compound of formula (d). The weight ratio of first to second aromatic tetracid dianhydride is 100:1-30. The weight ratio of end-capping agent to aromatic tetracid dianhydride to aromatic diamine is 5-80:100:30-150. Preferred Method: The step (C) is carried out at 5-40 degrees C for 1-10 hours. Esterification is processed under heating refluxing condition at 65-140 degrees C for 1-6 hours. The method further comprises heating polyimide resin solution to obtain solid polyimide resin.

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Record 5 of 17

Patent Number(s): CN101602856-A

Title: Novel polyimide resin for forming carbon fiber reinforced resin matrix composite material, has having phenylacetylene naphthalic anhydride group at terminal

Inventor Name(s): FAN L; YANG S; YANG Y

Patent Assignee(s): CHINESE ACAD SCI CHEM INST (CSCI)

Abstract: NOVELTY - A polyimide resin having phenylacetylene naphthalic anhydride group at terminal (1) is new.

USE - Novel polyimide resin having phenylacetylene naphthalic anhydride is used for forming carbon fiber reinforced resin matrix composite material (claimed), aerospace and aircraft.

ADVANTAGE - The polyimide resin is heat-cured even at low temperature.

DETAILED DESCRIPTION - A polyimide resin having phenylacetylene naphthalic anhydride group at terminal of formula (1) is new.

R1-R5=H, fluoro, trifluoromethyl, methyl, ethyl, methoxy, phenyl or phenoxy;

R1'=group formed by m aromatic diamine molecule;

R2'=group formed by n aromatic dianhydride molecule;

m=1-11;and

n=1-10.

The pyrrolidine-2,5-dione ring of polyimide resin (1) on both side of R2' may be directly connected. INDEPENDENT CLAIMS are included for the following:

(1) preparation of polyimide resin having phenylacetylene naphthalic anhydride (1); and

(2) usage of polyimide resin having phenylacetylene naphthalic anhydride (1), which involves weaving carbon fiber or glass fiber to prefabricated component, adding the prefabricated component into a closed mold, heating, melting, forming low-viscosity melt, injecting the melt to the mold, injecting the polyimide resin, heating at 310-370 degrees C for 1-2 hours, curing and cooling and obtaining carbon fiber reinforced resin matrix composite material.

Technology Focus/Extension Abstract: TECHNOLOGY FOCUS - POLYMERS - Preparation Claimed: An aromatic diamine (in mol parts) (1-11) is added to an organic solvent in presence of nitrogen, the aromatic diamine is dissolved, aromatic dianhydride (0-10) is added, reacted at room temperature for 1-10 hours and phenylacetylene naphthalic anhydride (2) of formula (II) as terminal agent is added, to obtain reaction mixture. Then, the reaction mixture is heated at 30-150 degrees C for 1-10 hours, to obtain organic solution of polyamide acid prepolymer. The, inert aromatic solvent is added, the temperature is increased to reflux, water is removed using water separating device, the temperature is further increased to separate the inert aromatic solvent, and the reaction solution is deposited into inert solvent, to obtain deposited product. The obtained deposited product is washed and dried, to obtain polyimide resin having phenylacetylene naphthalic anhydride at terminal. The content of aromatic diamine, aromatic dianhydride and phenylacetylene naphthalic anhydride in the solution is 5-60 weight%. Preferred Compounds: The organic solvent is chosen from N,N-dimethylformamide, N,N-dimethylacetamide, N-methyl-2-pyrrolidone and/or metacresol. The aromatic diamine is chosen from 3,4'-diaminodiphenyl ether, 4,4'-diaminodiphenyl ether, 1,3-di(4-aminophenoxy)phenyl, 1,4-di(4-aminophenoxy)phenyl, 4,4'-diaminodiphenyl methane, 4,4'-di(4-amino-2-trifluoromethylphenoxy)phenyl, 4,4'-di(4-aminophenoxy)biphenyl, 4, 4'-di(4-amido amino-2-trifluoromethylphenoxy)biphenyl, 4,4'-diamino-2,2'-trifluoromethyl-biphenyl, phenylene diamine and/or meta-phenylenediamine. The aromatic dianhydride is chosen from 3,3',4,4'-biphenyl tetracarboxylic dianhydride, 2,3,3',4'-biphenyl tetracarboxylic dianhydride, 3,3',4,4'-dimethylphenoxy-tetracarboxylic dianhydride, 3,3',4,4'-benzophenone tetracarboxylic dianhydride



and/or 4,4'-(hexafluoroisopropyl). The inert aromatic solvent is chosen from methylbenzene, 1,3-dimethylbenzene, 1,4-dimethylbenzene, 1,3-diethylbenzene, 1,4-diethylbenzene and/or 1-methyl-2-ethyl benzene. The inert solvent is chosen from water, methanol, ethanol, propanol, isopropanol, acetone, tetrahydrofuran and dioxane.

Preferred Definitions:

R1'=x aromatic diamine chosen from 3,4'-diaminodiphenyl ether, 4,4'-diaminodiphenyl ether, 1,3-di(4-aminophenoxy)phenyl, 1,4-di(4-aminophenoxy)phenyl, 4,4'-diaminodiphenyl methane, 4,4'-di(4-amino-2-trifluoromethylphenoxy)phenyl, 4,4'-di(4-aminophenoxy)biphenyl, 4,4'-di(4-amido-amino-2-trifluoromethylphenoxy)biphenyl, 4,4'-diamino-2,2'-trifluoromethyl-biphenyl, phenylene diamine and meta-phenylenediamine;

x=m or less;

R2'=y aromatic dianhydride chosen from 3,3',4,4'-biphenyl tetracarboxylic dianhydride, 2,3,3',4'-biphenyl tetracarboxylic dianhydride, 3,3',4,4'-dimethylphenoxy-tetracarboxylic dianhydride, 3,3',4,4'-benzophenone tetracarboxylic dianhydride, 4,4'-(hexafluoroisopropyl) and 1,2,4,5-benzene tetramellitic anhydride;and

y=1-6 or n or less.

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Record 6 of 17

Patent Number(s): CN101560371-A

Title: New polyimide adhesive for binding high temperature resistant parts used in the fields of aviation, aerospace, precise machine and petrochemical industry

Inventor Name(s): FAN L; NIE H; SUN H; YANG S

Patent Assignee(s): CHINESE ACAD SCI CHEM INST (CSCI)

Abstract: NOVELTY - A polyimide adhesive is new.

USE - A polyimide adhesive for binding high temperature resistant parts used in the fields of aviation, aerospace, precise machine and petrochemical industry.

ADVANTAGE - The polyimide adhesive has excellent heat resistance, binding performance, high solid content and good storage stability.

DETAILED DESCRIPTION - A polyimide adhesive of formula (I) is new.

R1, R1'=one or more of 12 compounds, e.g. formulae (a) and (b);

R2, R2'=-O-, -C(=O)- or -S(=O)(=O)-;

x=1;

y=0-1

n=1-15.

An INDEPENDENT CLAIM is included for preparation of polyimide adhesive.

Technology Focus/Extension Abstract: TECHNOLOGY FOCUS - ORGANIC CHEMISTRY - Preferred Components: The organic solvent comprises N-methylpyrrolidone, N,N-dimethylformamide, N,N-dimethylacetamide, dimethyl sulfoxide, tetrahydrofuran and/or m-cresol. The aromatic diamine comprises 1,4-bis(4'-amino-2'-trifluoromethyl-phenoxy)benzene, 4,4'-bis(4'-amino-2'-trifluoromethyl-phenoxy)biphenyl, 4,4'-diaminodiphenyl sulfone, 3,3'-diaminodiphenyl sulfone, 4,4'-diaminotoluene ketone, 1,3-bis(4'-aminophenoxy)benzene, 1,3-bis(3'-aminophenoxy)benzene, 4,4'-diaminodiphenyl ether, 3,4'-diaminodiphenyl ether, p-phenylenediamine and/or m-phenylenediamine. The aromatic tetracarboxylic dianhydride comprises dianisole-3,3',4,4'-tetracarboxylic dianhydride, diphenylketone-3,3',4,4'-tetracarboxylic dianhydride and/or diphenylsulfone-3,3',4,4'-tetracarboxylic dianhydride. The end-capping agent is 4-phenylethynylphthalic anhydride. Preferred Composition: The aromatic diamine is 15-250 pts.wt.; the aromatic tetracarboxylic dianhydride is 50-400 pts.wt.; the end-capping agent is 5-100 pts.wt.; and the organic solvent is 400-2000 pts.wt.; and the toluene is 50-400 pts.wt..

TECHNOLOGY FOCUS - POLYMERS - Preparation (claimed): The polyimide adhesive is prepared by:(A) stirring aromatic diamine, aromatic tetracarboxylic dianhydride and end-capping agent in organic solvent for 1-3 hours, heating at 70-90 degrees C and continuously stirring for 4-8 hours to obtain homogeneous solution;(B) adding toluene into homogeneous solution, heating at 170-190 degrees C for 6-12 hours to evaporate toluene, and stopping heating after reaching 200 degrees C; and(C) cooling reaction liquid at 80-120 degrees C, pouring into hot water for precipitation, washing, filtering and drying precipitate to obtain solid powders of polyimide adhesive. Preferred Method: The polyimide adhesive is dissolved in organic solvent to obtain polyimide adhesive solution. Preferred Composition: The polyimide adhesive solution comprises (pts.wt.) polyimide adhesive (20-80) and organic solvent (100).

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Record 7 of 17

Patent Number(s): CN101362700-A

Title: New bis ortho-hydroxy fluorine-containing aromatic diamine compound for use in preparation of resin, preferably photosensitive polyimide resin and photosensitive polybenzoxazole resin

Inventor Name(s): FAN L; LIU J; TAO L; YANG H; YANG S

Patent Assignee(s): CHINESE ACAD SCI CHEM INST (CSCI)

Abstract: NOVELTY - A bis ortho-hydroxy fluorine-containing aromatic diamine compound is new.

USE - A bis ortho-hydroxy fluorine-containing aromatic diamine compound for use in preparation of resin, preferably photosensitive polyimide resin and photosensitive polybenzoxazole resin (claimed).

DETAILED DESCRIPTION - A bis ortho-hydroxy fluorine-containing aromatic diamine compound of formula (I) is new.

A, G, Q, D, E=H, F, -CF<sub>3</sub>, -C(CH<sub>3</sub>)<sub>3</sub>, or -CH(CH<sub>3</sub>)<sub>2</sub>.

An INDEPENDENT CLAIM is included for preparing (I).

Technology Focus/Extension Abstract: TECHNOLOGY FOCUS - INORGANIC CHEMISTRY - Preferred Materials: The acid may be 36-38% hydrochloric acid. The nitrating reagent is 65-68% concentrated nitric acid or mixed strong acid obtained from 65-68% nitric acid and 36-38% hydrochloric acid, trifluoromethanesulfonic acid, methanesulfonic acid, and/or cerium nitrate. The catalyst is palladium/carbon, reduced iron powder, tin dichloride, sodium sulfate, or sodium hydrosulfide; and hydrazine hydrate or hydrochloric acid.

TECHNOLOGY FOCUS - ORGANIC CHEMISTRY - Preparation (Claimed): (I) is prepared by(A) reacting fluorine-containing acetophenone and phenol in a ratio of 1:2-10 at 50-180 degrees C to obtain fluorine-containing aromatic biphenol in the presence of acid catalyst;(B) performing nitration reaction at - 20-30 degrees C with a nitrating reagent and fluorine-containing aromatic biphenol compound mole ratio of 1.1-30:1 to obtain bis ortho-hydroxy fluorine-containing aromatic dinitro compound; and(C) performing catalytic hydrogenation with a catalyst to dinitro compound mass ratio of 0.001-10:1.0. Preferred Materials: The acid may be methanesulfonic acid, trifluoromethanesulfonic acid, trifluoroacetic acid, or p-toluenesulfonic acid.

Preferred Definitions:

(1) A, J, D, E=H; and G=-CF<sub>3</sub>;

(2) A, J, C, E=H; and G, D=-CF<sub>3</sub>;

(3) A, G, D, E=H; and

J=-CF<sub>3</sub>;

(4) A, J, D, E=H; and

G=-C(CH<sub>3</sub>)<sub>3</sub>;

(5) A, J, D, E=H; and G=-CH(CH<sub>3</sub>)<sub>2</sub>;

(6) A, G, D, E=H; and J=-C(CH<sub>3</sub>)<sub>3</sub>;

(7) A, G, D, E=H; and J=-CH(CH<sub>3</sub>)<sub>2</sub>; or

(8) A, J, E=H; and G, D=-C(CH<sub>3</sub>)<sub>3</sub>.

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Record 8 of 17

Patent Number(s): CN101289542-A

Title: Preparation of ball typed silicon dioxide/polyimide composite film useful as lapping isolating film comprises dispersing ball typed silicon dioxide particle in organic solvent, reacting, coating, heating and analyzing imide reaction

Inventor Name(s): YANG S; RUI J; FAN L

Patent Assignee(s): CHINESE ACAD SCI CHEM INST (CSCI)

**Abstract:** NOVELTY - Preparation of ball typed silicon dioxide/polyimide composite film comprises (1) dispersing ball typed silicon dioxide particle into organic solvent uniformly; (2) dissolving surface processing agent, molecular weight regulator and adhesion promoter, flattening agent and aromatic diamine into ball typed silicon dioxide particle suspension prepared in (1) and adding organic dicarboxylic anhydride, stirring for reacting; and (3) coating mixing resin solution obtained in (2) into flat substrate surface, heating to volatilize solvent and analyzing imide reaction and obtain final product.

**USE** - The process is useful for preparing ball typed silicon dioxide/polyimide composite film which is useful as lapping isolating film of corona resistance covered wire in frequency control electronic machine (all claimed).

**ADVANTAGE** - The prepared polyimide composite film has good mechanical property, excellent corona resistance performance, low thermal expansion coefficient and low water absorbing ratio, having important applying value in isolating system of frequency control electronic machine.

**DETAILED DESCRIPTION** - Preparation of ball typed silicon dioxide/polyimide composite film comprises (1) dispersing the ball typed silicon dioxide particle into the organic solvent uniformly to prepare the ball typed silicon dioxide particle suspension; (2) dissolving the surface processing agent, molecular weight regulator and adhesion promoter, flattening agent and aromatic diamine into ball typed silicon dioxide particle suspension, and adding organic dicarboxylic anhydride, stirring for reacting to prepare the ball typed silicon dioxide particle/polyimide mixing resin solution; and (3) coating the mixing resin solution into the flat substrate surface, heating to volatilize solvent and analyzing imide reaction, to obtain the ball typed silicon dioxide/polyimide composite film.

**Technology Focus/Extension Abstract:** TECHNOLOGY FOCUS - ORGANIC CHEMISTRY - Preferred Components: The surface processing agent is glycidoxypropyl trimethoxysilane, gamma - aminopropyltriethoxysilane, gamma - mercaptan aminopropyl trimethoxy silane, aniline methyl oxyethyl silane and/or 3,4-cyclohexene oxide propyl trimethoxy silane. The aromatic diamine is p-phenylene diamine, m-phenylene diamine, 4,4'-diaminodiphenyl ether (4,4'-ODA), 3,4'-diaminodiphenyl ether (3,4'-ODA), 4,4'-diaminodiphenylsulfone (4,4'-DDS), 4,4'-diaminodiphenylmethane (MDA), 3,3'-dimethyl-4,4'-diaminodiphenylmethane (DMDA), 3,3',5,5'-tetramethyl-diaminodiphenylmethane (TMDA), 1,3-di(4-aminophenoxy)phenyl (1,3,4-APB), 1,4-di(2-trifluoromethoxy-4-amino phenoxy)phenyl (6FAPB) and/or 4,4'-di(4-aminophenoxy)diphenyl sulfone. The organic dicarboxylic anhydride is pyromellitic dianhydride (PMDA), 3,3',4,4'-biphenyltetracarboxylic dianhydride (BPDA), 3,3',4,4'-diphenylether dicarboxylic anhydride (ODPA), 3,3',4,4'-benzophenone dicarboxylic anhydride (BTPA), 3,3',4,4'-triphenyl diether dicarboxylic anhydride (HQDPA) and/or 4,4'-hexafluoro isopropyl diphthalandione anhydride (6FDA). The organic solvent is N-methyl pyrrolidine, N,N'-dimethyl acetamide, N,N'-dimethylformamide, dimethyl sulfoxide and/or gamma -butyrolactone. The flattening agent is methyl phenol, ethylene glycol mono-butyl ether, ethylene glycol mono-butyl ether acetic ester and/or ethylene glycol ethyl ether acetic ester. The molecular weight regulator and adhesion promoter is gamma -aminopropyltriethoxysilane, gamma -aminopropyltrimethoxysilane, di( gamma -aminopropyl)tetramethyl siloxane, di( gamma -aminobutyl)tetramethyl siloxane, di( gamma -aminopropyl)tetramethyl polysiloxanes, di( gamma -aminopropyl)tetramethyl polysiloxanes, di( gamma -aminopropyl)tetraphenyl siloxane, di( gamma -aminopropyl)tetraphenyl polysiloxanes, di( gamma -aminobutyl)tetraphenyl siloxane and/or di( gamma -aminobutyl)tetraphenyl polysiloxanes.

TECHNOLOGY FOCUS - POLYMERS - Preferred Composition: The pts.wt. of each component of ball typed silicon dioxide/polyimide composite film is 1-40 pts.wt. of ball typed silicon dioxide particle, preferably 2-20 pts.wt.; 0.01-4 pts.wt. of surface processing agent, preferably 0.1-2 pts.wt.; 98-102 pts.wt. of aromatic diamine, preferably 98-102; 98-102 pts.wt. of organic dicarboxylic anhydride, preferably 98-102 pts.wt.; 500-10000 pts.wt. of organic solvent, preferably 500-10000; 1-10 pts.wt. of flattening agent, preferably 1-5; 0.01-10 pts.wt. of molecular weight regulator, preferably 1-5 and adhesion promoter. Preferred Parameters: The particle diameter of ball typed silicon dioxide particle ranges from 0.02-50  $\mu\text{m}$ , preferably 0.02-20  $\mu\text{m}$ . Preferred Conditions: In heating in (3) using ladder heating method, the ladder temperature and processing time are processing for 1-10 hours at 40 degrees C, processing for 1-4 hours at 100 degrees C, processing for 1-4 hours at 150 degrees C, processing for 1-4 hours at 200 degrees C, processing for 1-4 hours at 250 degrees C, processing for 1-4 hours at 300 degrees C, processing for 1-4 hours at 400 degrees C.

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Record 9 of 17

Patent Number(s): CN101077798-A; CN100593520-C

Title: Polyimide copolymer pervaporation separation membrane for treating phenolic waste water comprises epidermal layer which is an ultrathin dense separation layer and porous steadying layer

Inventor Name(s): WANG L; LIU B; TIAN Y; NING H; DING H

Patent Assignee(s): CHINA ACAD SCI CHEM RES INST (CHSC-Non-standard); CHINESE ACAD SCI CHEM INST (CSCI)

Abstract: NOVELTY - An unsymmetrical polyimide copolymer pervaporation separation membrane comprises an epidermal layer which is an ultrathin dense separation layer and a porous steadying layer which plays action under the epidermal layer. The polyimide copolymer is formed from fluoric dianhydride and two diamines three-element monomers where the two diamines is fluoric diamine and carboxylic diamine which has a mole ratio of 1:1-5:1. The mole ratio of dianhydride and diamine is 1:1. The membrane is 20-60  $\mu\text{m}$  thick.

USE - The polyimide copolymer pervaporation separation membrane is useful for treating phenolic waste water.

ADVANTAGE - The membrane divides raw material stream into lower phenolic content retentate and high phenolic content collation.

DETAILED DESCRIPTION - An INDEPENDENT CLAIM is included for a method for preparing the polyimide copolymer pervaporation separation membrane comprising dissolving polyimide copolymer of fluoric dianhydride, fluoric diamine and carboxylic diamine into solvent and then adding nonsolvent (5-10 wt.%) and organic acid (1-3 wt.%) to obtain casting film liquid; subjecting casting film liquid on polyester non-woven fabrics; filtering, deaerating and solidifying gel at 8-20°C for 10-120 seconds to obtain unsymmetrical polyimide copolymer pervaporation separation membrane; and washing unsymmetrical separation membrane using acetone or isopropanol and then vacuum drying at 80-120°C to obtain desired product.

DESCRIPTION OF DRAWING(S) - The drawing is a schematic diagram illustrating a method for preparing a polyimide copolymer pervaporation separation membrane.

Technology Focus/Extension Abstract: TECHNOLOGY FOCUS - ORGANIC CHEMISTRY - Preferred Components: The fluorine diamine is 4,4'-hexafluorobis(isopropyl)-phthalic anhydride or 2,2-di(4-(4-aminophenoxy)phenyl)hexafluoropropane. The carboxylic diamine is 3,5-diaminobenzoic acid. The acid solution is N,N-dimethyl formamide, N,N-dimethyl acetamide or N-methyl-2-pyrrolidone. The nonsolvent is acetone, butanone or isopropanol.

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Record 10 of 17

Patent Number(s): CN101062980-A; CN100569833-C

Title: New fluorine-containing thermoplastic polyimide polymer, e.g. for making resin components or thin film and resin radical compounding material

Inventor Name(s): YANG S; CHEN J; FAN L

Patent Assignee(s): CHINA SCI ACAD CHEM INST (CHSC-Non-standard); CHINESE ACAD SCI CHEM INST (CSCI)

Abstract: NOVELTY - Fluorine-containing thermoplastic polyimide polymer is new.

USE - The new fluorine-containing thermoplastic polyimide polymer is for making resin components, thin film and resin radical compounding material; and for application in spaceflight, aviation, electronics, microelectronics, refined machine, petrochemical industry, or automobile industry.

ADVANTAGE - The fluorine radical and the ether bond in the main chain structure of polyimide can reduce rigidity of molecule chain and acting force among molecule chains, and has good effect on improving polyimide's dissolution nature and fusion processability. Further, the thermoplastic polyimide polymer has good heat stability and mechanical property.

DETAILED DESCRIPTION - A fluorine-containing thermoplastic polyimide polymer of formula (I) is new.

R1=-O-, -C(O)-, or C(CF<sub>3</sub>)<sub>2</sub>;

R2=one or more of compounds (a)-(c);

R3=one or more of 8 compounds, e.g. of formulae (1), (2), or (8);

x=1-50; and

y=0-50.

An INDEPENDENT CLAIM is included for a method of preparing fluorine-containing thermoplastic polyimide polymer.

Technology Focus/Extension Abstract: TECHNOLOGY FOCUS - ORGANIC CHEMISTRY - Preparation (Claimed): Fluorine-containing thermoplastic polyimide polymer is prepared by mixing aromatic organic tetracid dianhydride monomer, aromatic diamine monomer, and anhydride blocking agent in presence of inert gases; adding solvent to make solid content at 2-50%; adding toluene as azeotrope agent and isoquinoline as catalyst; and reacting for 2-30 hours at 150-200 degrees C to remove the solvent to obtain fluorine-containing thermoplastic polyimide polymer. Preferred Component: The

aromatic organic tetracid dianhydride monomer is 3,3',4,4'-biphenyl tetracid dianhydride; 3,3',4,4'-diphenyl methyl ether tetracid dianhydride; 3,3',4,4'-diphenyl methyl ketone tetracid dianhydride; or 4,4'-(hexafluoro-isopropyl) di-benzene tetracid dianhydride. The aromatic diamine monomer is 1,4-di-(4'-amido-2'-trifluoromethylphenoxy) benzene; 4,4'-di-(4-amido-2-trifluoromethylphenoxy) biphenyl; 4,4'-di-(3-amido-5-trifluoromethylphenoxy) biphenyl; 3,4'-diamido diphenylate; 4,4'-diamido diphenylate; Ursol(RTM: paraphenylene diamine); 1,3-di-(4-amido-phenoxy) benzene; or metaphenylene diamine. Preferred Composition: Weight ratio of aromatic organic tetracid dianhydride monomer, aromatic diamine monomer, and blocking agent is 100:20-300:0.1-40. Preferred Component: The solvent is m-cresol, methyl pyrrolidone, N,N-dimethyl formamide, or N,N-dimethyl acetamide. Preferred Method: The method further comprises dissolving aromatic diamine monomer into a non-polar solution, adding aromatic organic tetracid dianhydride monomer and blocking agent to react for 5-48 hours to obtain polyamide acid solution, and coating polyamide acid solution to make polyimide polymer film.

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Record 11 of 17

Patent Number(s): CN1970603-A

Title: Intrinsic fluorinated photosensitive polyimide resin and its preparation method

Inventor Name(s): YANG S; LI H; FAN L; LIU J

Patent Assignee(s): CHINESE ACAD SCI CHEM INST (CSCI)

Abstract: NOVELTY - The invention discloses an intrinsic-typed photoactive polyimide resin and making method, which is polycondensated by 3,3',4,4'-benzophenone pyromellitic dianhydride 40 with polyalkyl substituted aromatic methane diamine 20-42 as fluorine aromatic lateral group, wherein the carbon atom number of A, B, C and D in the formula I is 1-10; E, F, G is H atom or trifluoromethyl. The invention possess superior solubility, which can be reserved for half year under indoor temperature and 18 months under 4 deg.c.

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Record 12 of 17

Patent Number(s): CN1978487-A

Title: 4-penylacetylene-3-trifluoromethyl-aniline and its polyimide resin as well as preparation method

Inventor Name(s): YANG S; CHEN J; FAN L; LI Z

Patent Assignee(s): CHINESE ACAD SCI CHEM INST (CSCI)

Abstract: NOVELTY - This invention claims a 4-penylacetylene-3-trifluoromethyl-aniline and its polyimide resin as well as preparation method.

DETAILED DESCRIPTION - Monocase comprising fluorinated phenyl thynylaniline provided by the invention is 4-penylacetylene-3-trifluoromethyl-aniline. Structure of it is showed by expression I. 4-penylacetylene-3-trifluoromethyl-aniline of the invention can be blocking agent of polyimide resin.

Prepared polyimide resin solvent has characteristics of high solid content, low viscosity, good storing stability, which is applied to infuse carbon fiber, glass fiber or aramid fiber. It can be prepared as prepreg (strip or cloth) with high quality. The prepreg prepared has great complex material modeling manufacturing capability. Complex material after 50 to 380 centigrade hot solidifying workcraft has low porosity, great heat resistance, high mechanical property, which is taken as light high temperature resisting structure part or sub structure part. It has potential applicable value in hi-tech field such as space flight, aviation, space technology and so on.

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Record 13 of 17

Patent Number(s): CN1900164-A; CN100462403-C

Title: Blend of polyimide polymer and its use as high temperature resisting dipping glue

Inventor Name(s): WANG X; YANG K; HU A; YANG S; FAN L; YU G; XUAN L; LU W

Patent Assignee(s): MARINE CHEM INST (MARI-Non-standard); MARINE RES INST CHEM IND (MARI-Non-standard); CHINESE ACAD SCI CHEM INST (CSCI)

Abstract: NOVELTY - The present invention discloses a kind of heat resistant dipping glue comprising two kinds of blended polyimide polymer. The first polyimide polymer is prepared with aromatic fluoric diamine and aromatic tetracid dihydride and through a two-step condensation reaction in organic solvent and under the action of catalyst. The second polyimide polymer is prepared with aromatic tetracid dihydride and aromatic diisocyanate and through a one-step condensation reaction in organic solvent and under the action of catalyst. These two kinds of polyimide polymer are blended in the weight ratio of 2-10 to 1. The heat resistant dipping glue is used in dipping carbon fiber honeycomb material, glass fiber honeycomb material and paper honeycomb material to obtain reinforced heat resistant sandwiched material.

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Record 14 of 17

Patent Number(s): CN1810856-A; CN100491446-C

Title: Aromatic polyimide preparation method, involves dissolving aromatic organic diamine in organic solvent, adding fluorine-containing aromatic organic tetraaciddihydride, and stirring mixture under protection of nitrogen

Inventor Name(s): YANG S; GE Z; YAN L

Patent Assignee(s): CHINESE ACAD SCI CHEM INST (CSCI)

Abstract: NOVELTY - The present invention relates to aromatic polyimide and its preparation and use. Aromatic organic diamine is dissolved in 5-20 times of organic solvent, fluorine-containing aromatic organic tetraaciddihydride or its derivative in the same amount as the aromatic organic diamine is added into the solution at 0-4 deg.c, and the mixture is stirred at room temperature under protection of nitrogen to react for 10-24 hr to obtain polyamic acid solution. The polyamic acid solution is coated onto the surface of glass or silicon chip and heated to 250-350 deg.c so as to