US009409777B2

(12) **United States Patent**
Geramita et al.

(10) **Patent No.: US 9,409,777 B2**
(45) **Date of Patent: *Aug. 9, 2016**

(54) **PREPARATION OF POLYMERIC RESINS AND CARBON MATERIALS**

(71) Applicant: **BASF SE**, Ludwigshafen (DE)

(72) Inventors: **Katharine Geramita**, Seattle, WA (US); **Benjamin Kron**, Seattle, WA (US); **Henry R. Costantino**, Woodinville, WA (US); **Aaron M. Feaver**, Seattle, WA (US); **Avery J. Sakshaug**, Lynnwood, WA (US); **Leah A. Thompkins**, Seattle, WA (US); **Alan Tzu-Yang Chang**, Renton, WA (US)

(73) Assignee: **BASF SE**, Ludwigshafen (DE)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 363 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **13/763,448**

(22) Filed: **Feb. 8, 2013**

(65) **Prior Publication Data**

US 2013/0280601 A1 Oct. 24, 2013

Related U.S. Application Data

(60) Provisional application No. 61/597,121, filed on Feb. 9, 2012.

(51) **Int. Cl.**

C01B 31/00	(2006.01)
C08G 8/22	(2006.01)
H01M 4/587	(2010.01)
H01M 4/133	(2010.01)
H01M 4/14	(2006.01)
H01M 4/36	(2006.01)
H01M 4/96	(2006.01)
H01G 11/34	(2013.01)
H01G 11/44	(2013.01)
C01B 31/02	(2006.01)
C01B 31/10	(2006.01)
H01M 4/62	(2006.01)
H01M 10/0525	(2010.01)
H01M 10/06	(2006.01)
H01M 12/06	(2006.01)

(52) **U.S. Cl.**

CPC ***C01B 31/00*** (2013.01); ***C01B 31/02*** (2013.01); ***C01B 31/10*** (2013.01); ***C08G 8/22*** (2013.01); ***H01G 11/34*** (2013.01); ***H01G 11/44*** (2013.01); ***H01M 4/133*** (2013.01); ***H01M 4/14*** (2013.01); ***H01M 4/36*** (2013.01); ***H01M 4/587*** (2013.01); ***H01M 4/96*** (2013.01); *H01M 4/625* (2013.01); *H01M 10/0525* (2013.01); *H01M 10/06* (2013.01); *H01M 12/06* (2013.01); *Y02E 60/13* (2013.01)

(58) **Field of Classification Search**

CPC C01B 31/00

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,518,123	A	6/1970	Katsoulis et al.
3,619,428	A	11/1971	David
3,876,505	A	4/1975	Stoneburner
3,977,901	A	8/1976	Buzzelli
4,082,694	A	4/1978	Wennerberg et al.
4,159,913	A	7/1979	Birchall et al.
4,198,382	A	4/1980	Matsui
4,206,095	A	6/1980	Wynstra et al.
4,543,341	A	9/1985	Barringer et al.
4,580,404	A	4/1986	Pez et al.
4,843,015	A	6/1989	Grubbs, Jr. et al.
4,862,328	A	8/1989	Morimoto et al.
4,873,218	A	10/1989	Pekala
4,954,469	A	9/1990	Robinson
4,997,804	A	3/1991	Pekala
5,093,216	A	3/1992	Azuma et al.
5,260,855	A	11/1993	Kaschmitter et al.
5,416,056	A	5/1995	Baker
5,420,168	A	5/1995	Mayer et al.
5,465,603	A	11/1995	Anthony et al.
5,508,341	A	4/1996	Mayer et al.
5,529,971	A	6/1996	Kaschmitter et al.
5,583,162	A	12/1996	Li et al.
5,626,637	A	5/1997	Baker
5,626,977	A	5/1997	Mayer et al.
5,674,642	A	10/1997	Le et al.
5,710,092	A	1/1998	Baker
5,789,338	A	8/1998	Kaschmitter et al.
5,858,055	A	1/1999	Jahnke et al.

(Continued)

FOREIGN PATENT DOCUMENTS

CA	2176452	A1	11/1997
CN	1762900	A	4/2006
CN	101194384	A	6/2008
CN	101604743	A	12/2009
CN	101969120	A	2/2011

(Continued)

OTHER PUBLICATIONS

Costantino et al, "Carbon-Based Compositions with Highly Efficient Volumetric Gas Sorption," U.S. Appl. No. 14/533,956, filed Nov. 5, 2014, 90 pgs.

(Continued)

Primary Examiner — Stuart Hendrickson

(74) *Attorney, Agent, or Firm* — Seed IP Law Group PLLC

(57) **ABSTRACT**

The present application is directed to methods for preparation of carbon materials. The carbon materials comprise enhanced electrochemical properties and find utility in any number of electrical devices, for example, as electrode material in ultracapacitors or batteries.

18 Claims, 23 Drawing Sheets