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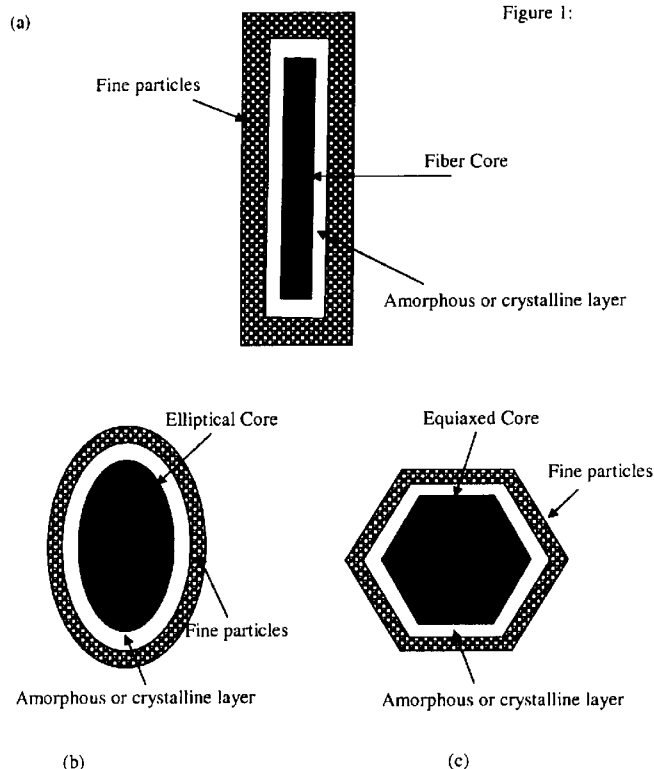
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[Continued on next page]

(54) Title: BONDING ELEMENT, BONDING MATRIX AND COMPOSITE MATERIAL HAVING THE BONDING ELEMENT, AND METHOD OF MANUFACTURING THEREOF



(57) Abstract: A bonding element, a bonding element matrix and composite materials with a wide range of attractive properties that may be optimized, including, but not limited to, mechanical properties, thermal properties, magnetic properties, optical properties and nuclear properties, as a result of a first layer and second layer structure or core, first layer, and second layer structure of the bonding elements, as well as methods for making the bonding elements and the corresponding ceramic and/or composite materials.



DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT,
LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE,
SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA,
GN, GQ, GW, ML, MR, NE, SN, TD, TG).

— *before the expiration of the time limit for amending the
claims and to be republished in the event of receipt of
amendments (Rule 48.2(h))*

Published:

— *with international search report (Art. 21(3))*

(88) Date of publication of the international search report:

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2012/027536

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - C04B 35/64 (2012.01)

USPC - 501/154

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC(8) - C03B 19/06; C04B 35/01, 35/26, 35/42, 35/47, 35/49, 35/64, 35/447, 35/457, 35/468, 35/491, 35/495, 35/553, 41/00, 4(2012.01)
USPC - 65/21.2; 264/642; 423/301, 308, 430, 594.1, 594.3, 594.9, 596, 598; 428/221, 319.1, 357, 375, 380; 501/141,154

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

PatBase, Google Patents, Proquest, Engineering Village, Google

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2009/0142578 A1 (RIMAN et al) 04 June 2009 (04.06.2009) entire document	1-108
A	US 2004/0131531 A1 (GEERLINGS et al) 08 July 2004 (08.07.2004) entire document	1-108
A	US 2009/0143211 A1 (RIMAN et al) 04 June 2009 (04.06.2009) entire document	1-108
A	US 7,670,679 B2 (KRISHNA et al) 02 March 2010 (02.03.2010) entire document	1-108
A	US 5,449,533 A (MORIZANE) 12 September 1995 (12.09.1995) entire document	1-108
A	US 4,528,149 A (WICHELHAUS et al) 09 July 1985 (09.07.1985) entire document	1-108
A	RIMAN et al. Hydrothermal crystallization of ceramics. Riman et al. Ann. Chim. Sci. Mat. 27 (6), pp. 15-36, 2002. Retrieved from the internet. Retrieved on [07.31.2012] <URL: http://downloads.olisystems.com/ResourceCD/Ceramic%20Synthesis/MaterialsCrystallization.pdf > entire document	1-108

☐ Further documents are listed in the continuation of Box C.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

01 August 2012

Date of mailing of the international search report

18 SEP 2012

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2012/027536

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees need to be paid.

Group I: claims 1-86 are drawn to bonding elements and matrices. Group II: claims 87-108 are drawn to methods of making composites.

The inventions listed in Groups I and II do not relate to a single general inventive concept under PCT Rule 13.1, because under PCT Rule 13.2 they lack the same or corresponding special technical features for the following reasons: The special technical features of Group I, a bonding material including a core having first and second layers of different chemical compositions, are not present in Group II; and the special technical features of Group II, methods for preparing a composite by presenting a plurality of reactive porous precursor particles wherein liquid solvents and gaseous reactants are introduced to the pores to form bonding elements, are not present in Group I.

Groups I and II therefore lack unity under Rule 13 because they do not share a same or corresponding special technical feature.

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.