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Office of Technology Management
The Pennsylvania State University
113 Technology Center, University Park, PA 16802
814.865.6277 phone: 814.865.3591 fax

Non-Confidential Description - PSU No. 3158
"Core-Shell Microstructure Proppants"

Keywords:

proppants, hydrofracturing, hydraulic fracturing, fracing

Links:

Inventor Website - 1
Inventor Website - 2
Published patent application
US Patent 7,828,998

Inventors:

Walter G. Luscher, John R. Hellmann, Barry E. Scheetz

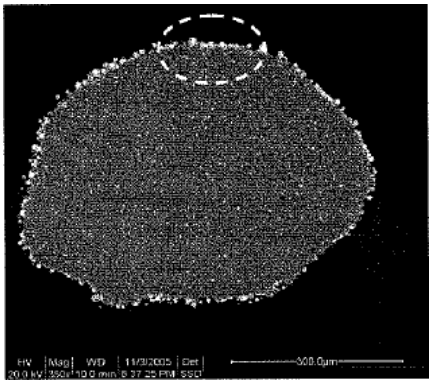

Fig. 1: Proppant with core-shell microstructure

Background

Ceramic type mineral materials generally combine high strength with chemical and thermal stability. Hence they have significant utility in many products and processes. For example, ceramic-based materials are often used as supports for catalysts and as casting sands and mold materials used for the fabrication of a variety of articles in high temperature fabrication processes. Particulate ceramic materials also have significant utility as proppants in hydrocarbon recovery processes. Such materials are injected, under very high pressures, into geological structures, together with carrier fluids in a process called hydrofracturing. The injected fluid opens cracks in rock structures whereby the proppant materials wedge into these opened cracks and serve to maintain the integrity and permeability of the cracked structure during the extraction process. Such materials need to have high strength and chemical inertness, and should also have densities comparable to that of the carrier fluid. In addition, since these materials are used in very large amounts, their cost should be low.

Invention Description

The disclosed invention is an improved proppant having a ceramic core and a metal or metal oxide outer shell. They are made by a process that utilizes dopant-induced transient liquid phase sintering (TLPS) of mineral materials (e.g. aluminosilicates) to permit in-situ fabrication of ceramic aggregates/proppants with a core-shell microstructure (Fig. 1). This complex microstructure allows for the specific tailoring of material properties such as specific gravity, thermal expansivity, and thermal conductivity. By controlling these material properties, the disclosed process offers a superior alternative to existing proppant technologies and exhibits malleable potential uses, such as creating "proppants" in pore channels for hydrocarbon retrieval, to the creation of a permeable reactive barrier (PRB) in the environmental restoration of contaminated groundwater.

Advantages/Applications

- Proppant properties such as density, thermal conductivity, and strength can be tailored
- Densified outer shell increases resistance to failure under typical service loads

Contact: **Bradley A. Swope**
Sr. Technology Licensing Officer
The Pennsylvania State University

Phone: (814) 863-5987
Fax: (814) 865-3591
E-mail: bradswope@psu.edu

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- Relatively inexpensive when comparing to prior methods and materials

Contact: **Bradley A. Swope**
Sr. Technology Licensing Officer
The Pennsylvania State University

Phone: (814) 863-5987
Fax: (814) 865-3591
E-mail: bradswope@psu.edu