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Carbon Materials Technology Group
Metals and Ceramics Division

CRADA Final Report
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Slurry Molding Technologies for Novel Carbon and Graphite Materials

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1. Introduction

The Oak Ridge National Laboratory (ORNL) has developed a slurry molding technology for the manufacture of porous, high surface area, carbon fiber composites molecular sieves, and carbon-carbon composite preforms. Potentially, this technology could be applied to the manufacture of a host of novel carbon materials including porous adsorbent carbons, low-pressure drop adsorbent carbon composites, ultra-fine-grained graphite, and carbon fiber reinforced graphite.

New opportunities for high surface carbon fiber composite molecular sieve (CFCMS) materials are now emerging. Many of these opportunities are driven by increasingly harsh environmental pressures. Traditional granular activated carbon (GAC) is not suitable for many of these applications because of the difficulties encountered with attrition and in forming "structures" which have the necessary mechanical and physical properties. In addition, the electrical desorption of adsorbed species is not possible with GAC due to its low bulk electrical conductivity. Activated carbon fibers have been found to be useful in some applications. Work by ORNL has shown, for example, that CFCMS materials are capable of adsorbing various gases and desorbing them under electrical stimulation. For some applications these fibers have to be formed into a structure that can offer the desired mechanical integrity and pressure drop characteristics. To date, the work by ORNL has focused on the use of a single manufacturer's isotropic pitch fibers which, when activated, may be cost prohibitive for many applications.

Fine-grained graphite is attractive for many applications including the chemical processing industry where their unique combination of properties - including high strength and chemical inertness, are particularly attractive. However, a lack of toughness can limit their utility in certain applications. The use of ultra-fine powders in conjunction with slurry molding and hot pressing offers the possibility of higher strength graphite. Moreover, the inclusion of carbon fibers may provide a toughening mechanism, resulting in tougher, stronger graphite at an attractive cost.

2. CRADA Objectives

The objective of this work was to further develop the ORNL slurry molding technology and apply it to the following tasks: (i) the development of low cost, high surface area CFCMS materials and structures; (ii) the development of ultra-fine-grained graphite; and (iii) to identify suitable applications for the materials developed in (i) and (ii). The work was conducted jointly by SGL and ORNL

3. Technical Progress

<u>Task 1: Slurry molded high surface area composites</u>
Isotropic carbon fibers from alternative manufacturers were evaluated for potential use in ORNL's high surface area composites as replacements to the potentially cost prohibitive carbon fiber currently used. The results of this investigation showed that other isotropic

carbon fibers, besides the type currently used, have the capability for use in high surface area composite applications.

Task 2: New low pressure drop, high-surface area forms
Dr. Doug Wilson (SGL) supplied a novel sample from SGL for examination of its gas adsorption properties and potential application in low-pressure drop (pleated) filters. The sample was analyzed and found to have higher BET surface areas than current materials used for such filters.

Task 3: High-strength, fiber toughened, ultra-fine grained graphite
Fine graphite materials from certain process streams in SGL's manufacturing system were supplied to ORNL. These graphites were pressed or formed into artifacts by different pressing methods. The mechanical, thermal, and tribological properties of the artifacts were determined by various methods and shown, in some cases, to be superior to commercially available products.

4. Subject Inventions

A patent disclosure was prepared for the new graphite technology described in Section 3, Task 3 and a U.S. patent-application has been filed.

5. Plans for Future Collaboration

A statement of work has been written for Year 2 of the CRADA. The agreed upon objectives for Year 2 are: (i) develop or investigate novel carbons for gas separation, (ii) develop novel carbons for gas separations from by-product graphite or other carbon materials, (iii) collect irradiation data on nuclear grade graphites, and (iv) perform other research tasks that are mutually agreeable to both parties.

6. Acknowledgement

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