Glass/BNNT Composite for Sealing Solid Oxide Fuel Cells

Boron nitride nanotubes contribute to strength and fracture toughness.

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A material consisting of a barium calcium aluminosilicate glass reinforced with 4 weight percent of boron nitride nanotubes (BNNTs) has shown promise for use as a sealant in planar solid oxide fuel cells (SOFCs). The composition of the glass in question in mole percentages is 35BaO + 15CaO + 5Al2O3 + 10B2O3 + 35SiO2. The glass was formulated to have physical and chemical properties suitable for use as a planar-SOFC sealant, but has been found to be deficient in one aspect: it is susceptible to cracking during thermal cycling of the fuel cells. The goal in formulating the glass/BNNT composite material was to (1) retain the physical and chemical advantages that led to the prior selection of the barium calcium aluminosilicate glass as the sealant while (2) increasing strength and fracture toughness so as to reduce the tendency toward cracking.

In preparation for tests, panels of the glass/BNNT composite were hot pressed and machined into test bars. Properties of the test bars, including four-point flexure strength, modulus of elasticity, microhardness, and density were determined. In addition, fracture toughness was measured by the single-edge V-notch-beam method. Among the conclusions drawn from the results of the tests were that the flexure strength and fracture toughness of the glass/BNNT composite specimens were greater than those of neat glass specimens by amounts of about 90 percent and about 35 percent, respectively (see figure). It was further concluded that these increases would greatly prolong the lifetimes of SOFC seals, yet there would be little adverse effect on sealing behavior of the glass because the relatively small concentration of BNNTs needed to obtain these increases would not cause much change in the viscosity of the composite sealant material.

This work was done by Narottam P. Bansal and Janet B. Hurst of Glenn Research Center and Sung R. Choi of the University of Toledo. Further information is contained in a TSP (see page 1).

Inquiries concerning rights for the commercial use of this invention should be addressed to NASA Glenn Research Center, Innovative Partnerships Office, Attn: Steve Fedor, Mail Stop 4–8, 21000 Brookpark Road, Cleveland, Ohio 44135. Refer to LEW-18094-1.