PREPARATION OF BORON CARBIDE FIBER REINFORCED BORON CARBIDE MATRIX COMPOSITES

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ABSTRACT: Boron carbide in a fibrous form exhibits high strength, high modulus of elasticity, low density, chemical stability and good oxidation resistance. However, the process of fiberizing such a refractory, hard material by the usual methods, is virtually impossible. Thus, other methods are needed to overcome these problems. Starting with a boron-coated tungsten wire, B_4C was deposited from a mixture of BC_{13}, CH_4 and H_2 at 1100–1200°C. Boron carbide fibers were prepared by impregnation of rayon with a soluble boron compound followed by heating. Boron carbide whiskers were fabricated by vaporization of B_4C powder followed by condensation in a temperature gradient. None of these methods, however, prepared fibers that were completely B_4C and continuous. It will be shown that multifilament carbon yarn can be totally (or partially) converted to continuous B_4C yarn by reaction with BC_{13} and H_2 under controlled conditions at high temperatures.

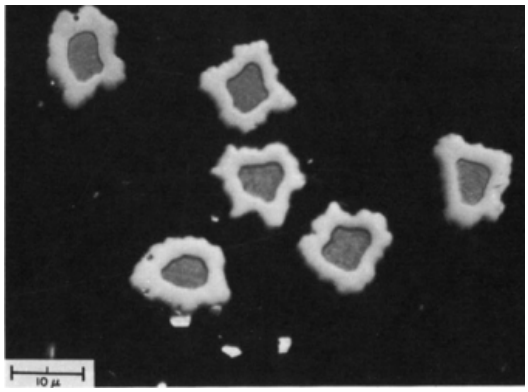

Figure 1: Cross section of B_4C fibers with moderate sized carbon cores (partially converted)

Method-1: Boron carbide fibers are prepared by heating boric acid in an ammonia atmosphere to a temperature of 350^o to 600^o C. the ammonia treated fibers are then heted in an amine atmosphere at atemperature of 600^o C. the amine trated fibers are further heated to a temperature of 2000^o C in an inert atmosphere producig the boron carbide fibers.

Method-2: Boron carbide fibers are prepared using diboron trioxide. The power is dispersed in a water slurry and cellulose fibers added to the water slurry. The diboron trioxide is dispersed in the cellulose matrix and carbonized to produced boron carbide fibers.

Method-3: continuous boron carbide fibers are prepared by a reacting continuous carbon fiber and boron oxide gas within a range of temperature of 1400^o C to 2000^o C.

Composite Preparation: The composite sintering product of the present invention comprises 90 to 50 vol% of boron carbide matrix reinforced with 10 to 50 vol% of boron carbide fibers. The preparation method comprises the following steps of: preparing a boron carbide fibers, three-dimensional weaving

process; and depositing boron carbide matrix on the boron carbide fiber preforms to form the compact boron carbide fiber reinforced boron carbide composite material.

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