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Synthesis of Carbide Powder in a Dual Drive Planetary Mill

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Abstract

Metal carbides possess unusual properties that make them desirable and useful engineering materials for many industrial applications. They have great hardness values, ranging between 20 and 30 GPa, between alumina and diamond. Most of the carbides have extremely high melting points (2000°C–3000°C). Some transition metal carbides (e.g. TiC, ZrC) exhibit non-linear variation of thermal and electrical conductivity with respect to temperature. One important property of the metal carbides is their chemical stability at room temperature—degrade slowly when subjected only to highly acidic environment. The metal carbides are generally very strong at high temperatures with extremely high values of Young's modulus, however, they are brittle at room temperature. They undergo a brittle-to-ductile transformation at around 1000°C. In fact, metal carbides are unique in that they combine the characteristic properties of metals and ceramics.

In this talk I will highlight the synthesis of cementite and silicon carbide from elemental iron/silicon and graphite powder in a specially built dual drive planetary ball mill. The mill that has 75-cm gyratory arm produces a force field of about 100G. At a micro level this force field has been found to be sufficient to allow reaction between respective elemental powders. The composite powder samples are analyzed at different intervals of milling time. It has been found that a volumetric ratio of 0.25 consistantly gave rise to maximum carbide yield. Powder samples are characterized by using laser particle size analyzer, BET surface area analyzer, X-ray diffractometer, DTA, SEM, TEM. Among other things, evidence of carbide formation at nano level is established.