INDUCTION PLASMA SYNTHESIS OF ULTRAFINE SIC

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Ultrafine powder of SiC has been prepared by various methods in d.c. plasma reactors, r.f. plasma reactors, SiC resistance element furnaces or by using microwave, laser or CVD techniques. A range of starting materials can be employed consisting of solid (Si, SiO_2), liquids (CH_3SiCl_3) or gases (SiH_4), with methane being used principally as a carburizing agent. The combination of the various SiC precursors associated with the different synthesis techniques shows various attempts to improve some of the following factors which are: SiC production rate, degree of conversion, powder quality (i.e. uniform nanoparticle size distribution, sinterability). The evolution of the development of processes involving ultrafine powder synthesis has always been to increase the residence time in the plasma reactor, by developing techniques such as the LIPS with the d.c. plasma or the induction plasma. The induction plasma has been widely used to synthesize SiC all around the world. Its unique features (no electrode contaminations, central injection, long residence time...) are very beneficial to processes which involve low cost solid precursors. As the typical application of SiC ultrafine powder is sintering of thermomechanical parts, the incorporation of sintering aids such as Boron has been found to be necessary. The techniques of induction plasma synthesis of Boron doped SiC is well adapted to the introduction of the required Boron, as BCl_3, during SiC vapour phase synthesis. Powder quality will be discussed as a function of sintering results for various r.f. plasma operation conditions. All along the review, the fundamental behavior of the SiC synthesis including momentum, heat and mass transfer, thermodynamics, heterogeneous kinetics as well as nucleation kinetics will be discussed in relation to experiments, diagnostics and modelling work.