

https://dspace.org/

The development of a diamond-silicon carbide composite

Mlungwane, Kekeletso

2009-05-08T11:27:55Z
http://hdl.handle.net/10539/6937

Downloaded from a DSpace repository. https://dspace.org/

PREFACE

Two routes of diamond-SiC composite manufacture under ambient pressure were followed, reaction-sintering and infiltration route. The reaction-sintered product is highly porous and has a low hardness value of 11 GPa. The infiltrated product on the other hand is fully dense, exhibits high hardness (> 35 GPa) and shows good wear properties under a cutting speed of 100 m/min.

Medium to coarse-grained diamond preforms (D[v, 0.9] of 16 to 22 μm) have been successfully infiltrated using molten silicon. The infiltration of fine-grained diamond preforms (D[v, 0.9] = 2 μm) using molten silicon is limited by the blocking of the pores as a result of the volume increase during the reaction of diamond with Si to form SiC. The preforms were prepared using phenolic resin as a binder. With increasing resin content the pore size increases, and the infiltration depth increases up to 10 wt% resin content. Full infiltration has been achieved at 5 and 10 wt% resin in the coarse and medium-grained preforms respectively. For the fine-grained diamond preforms, a maximum infiltration depth of 2.5mm was obtained using 10 wt% resin content. Reaction-choking is the predominant inhibitor to realization of full infiltration.

The investigation of the wetting behavior and the reaction to form SiC revealed that diamond is well wetted by molten silicon reaching a contact angle of about 20^{o} after its melting. The rate of SiC formation is initially very fast and slows down with time once a continuous product layer has formed.