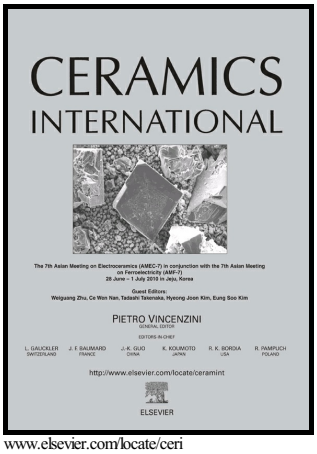

www.elsevier.com/locate/ceri

Fracture strength and toughness of chemical-vapor-deposited polycrystalline diamond films

Kang An, Liangxian Chen, Xiongbo Yan, Xin Jia, Jinlong Liu, Junjun Wei, Yuefei Zhang, Fanxiu Lu, Chengming Li

PII: S0272-8842(18)31699-7
DOI: https://doi.org/10.1016/j.ceramint.2018.06.253
Reference: CERI18697

To appear in: *Ceramics International*

Received date: 24 April 2018
Revised date: 11 June 2018
Accepted date: 28 June 2018

Cite this article as: Kang An, Liangxian Chen, Xiongbo Yan, Xin Jia, Jinlong Liu, Junjun Wei, Yuefei Zhang, Fanxiu Lu and Chengming Li, Fracture strength and toughness of chemical-vapor-deposited polycrystalline diamond films, *Ceramics International,* https://doi.org/10.1016/j.ceramint.2018.06.253

Fracture strength and toughness of chemical-vapor-deposited polycrystalline diamond films

Kang An[a], Liangxian Chen[a], Xiongbo Yan[a], Xin Jia[a], Jinlong Liu[a], Junjun Wei[a], Yuefei Zhang[b], Fanxiu Lu[a], Chengming Li[a*]

[a]*Institute of Advanced Materials and Technology, University of Science and Technology Beijing, Beijing 100083, P. R. China*

[b]*Institute of Microstructure and Property of Advanced Materials, Beijing University of Technology, Beijing 100124, P.R. China*

[*]Corresponding author. chengmli@mater.ustb.edu.cn.

Abstract

The strength of diamond films prepared by chemical vapor deposition (CVD) is usually much lower than that of natural-type IIa single-crystal diamonds. In this work, the fracture strength of free-standing diamond films deposited by direct current arc plasma jet CVD has been examined by conducting three-point bending experiments. The results obtained for both the polished and as-grown samples were in good agreement with a well-known Hall–Petch equation describing the relationship between the fracture strength and grain size, indicating that grain refinement represented an effective way of improving the mechanical properties of CVD diamond films. Furthermore, the diversification of the crystalline texture of the films achieved by polishing apparently increased their fracture strength, which was inversely proportional to the film thickness. A theoretical method for estimating the fracture strength of free-standing CVD diamond films by approximating their intrinsic strength was proposed, whereas their fracture toughness was determined by conducting simplified four-point bending tests at room temperature, 25 °C, using a single-edge pre-cracked beam method.

Keywords: A. Films. C. Fracture. C. Toughness and toughening. D. Carbon.

1. Introduction

Diamond films deposited by chemical vapor deposition (CVD) possess many advantages, including high hardness, small thermal expansion coefficient, large acoustic velocity, superior optical characteristics, and good heat conductivity [1-6]. These remarkable properties make CVD