

鑽石薄膜應變與應力之研究

The Study of Diamond Film on Strain and Residual Stress

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摘要

本研究係利用熱燈絲電漿 CVD 法 (HFPCVD) 及微波電漿 CVD 法 (MWPCVD) 在 WC+Co 基材上成長一薄層鑽石膜 (diamond film)，而鑽石膜之機械性質往往與薄膜內部殘留應力有關，殘留應力在薄膜元件之研究，普遍採用 X-光繞射儀進行分析探討，國內礙於儀器功能及分析軟體欠缺，實有美中不足之處；於本研究過程中嘗試以國內現有之 X 光繞射儀將鑽石膜應力與應變分析結果說明如下：

1. X-光繞射儀分析時，可利用所得在鑽石 (111) 面之晶面距離來與無應變狀態之鑽石膜比較，來計算之，可獲得巨觀方式鑽石膜內部總殘留應力及鑽石膜平面方向之殘留應力。實驗中嘗試利用 X-光繞射峰寬化之原理，參用半高寬值 (FWHM)，X 光波長及繞射角等參數，但因受平均晶粒大小及晶粒方向性影響很大，而未將結果採用之。
2. 實驗結果，鑽石膜隨著 CH₄% 之提高，其內部應力與應變，有下降趨勢。
3. WC+Co 基材上，Co 量改變時，以 12.5%Co 與 5.5%Co 基材之鑽石膜來比較，前者的內部殘留應力為小，這與基材之軟、硬度及熱膨脹係數有關。

ABSTRACT

A study of diamond film deposited by hot filament assisted CVD system system (HF CVD) and microwave plasma CVD system (MP CVD) on various cutting tool materials (ie. cemented WC). Effects of residual stress for diamond films adhesive properties.

To research residual stress for diamond films were measured by the X-ray diffraction technique.

In this investigation, preliminary results as followa:

1. By X-ray diffraction technique to analysis residual stress of the diamond films. In comparison with diamond films both crystal plane (111) distance and no strain crystal plan the film, and know macro-sopic residual stress produce on the diamond film, and try measured peak widths have no contribution from average particle size and grain texture effects.
2. The results show that a higher CH₄% concentration can be obtained for the diamond film under decrease residual stress and strain.
3. For the cemented carbides substrates, in comparison of the Co contents by two pieces of 12.5% Co and 5.5% Co substrate deposited diamond films, the results show 12.5% Co substrate have a lower residual stress. In this case, the relation between substrate soft or hard and thermal expansivity.