Effect of MgO interlayer on diamond film growth on silicon (100)

Abstract

Diamond films were grown, under identical conditions on scratched Si (100) with and without MgO interlayers by using hot filament chemical vapour deposition. Initially both kinds of the substrates were bias cd for 30 min at 7501 50 "C to enhance the nucleation density. A l:l00 vol.% mixture oi"Cl-l4 and H; gases was used for deposition at a total pressure of 4 x $I0^3$ Pa. Deposition was carried out for total 2 h and the analysis of the lilrns was carried out using Scanning Electron Microscopy, Atomic Force Microscopy. X-ray Diffraction and Raman Spectroscopy. Both substrates showed predorninantly (l l l) oriented crystals of diamond but with different surface morphology. The crystallites on scratched Si (I00) surface are in general (~l5~2 urn) and those on Mg0 overlayer are smaller (<l urn). but denser film occurs with MgO overlayer on Si (I00)
substrate.

I. Introduction

Interest in diamond film deposition continues as there are many application areas where unique properties of diamond are found to be useful and newer applications would be possible.

Natural diamond has amongst all known materials highest hardness. excellent tribological properties, chemical inertness, highest electrical resistivity and thermal conductivity, large transmission coefficient over visible and infrared spectrum of electromagnetic radiation and so on. However, natural diamonds are scarce and expensive. Therefore there were many attempts in the past to synthesize diamonds. First successful attempt by Bundy et al. in I955 at General Electric Co. in USA and some others around the same time [I] inspired many groups all over the world to follow High Pressure and High Temperature (HPHT) root to synthesize small crystals of diamond. However, the major breakthrough in diamond film growth from the application point of view can be attributed to the developments by Eversole [2], Spitsyn and Deryaguin [3] and Matsumoto et al. [4]. It was clear from their work that deposition of diamond films was possible at sub-atmospheric pressure using hydrocarbon gases. It was also

clear that diamond film deposition was possible on non-diamond substrates. thereby tremendously expanding the scope of applications. Subsequently a large number of deposition techniques like direct current plasma assisted chemical vapour deposition, radio frequency plasma assisted chemical vapour deposition, microwave plasma assisted hemical vapour deposition, hot filament chemical vapour deposition (H FCVD), electron cyclotron resonance (ECR), laser ablation, flame synthesis etc, have been shown to be capable of depositing diamond films. enriching the field. There are several books and review articles [5-8] which discuss synthesis methods. The properties and applications of diamonds and diamond thin films. However. deposition of diamond coatings from gases is a relatively slow process. Although in most cases Si is a preferred
substrate. carbidic or noncarbidic solids, noble metals. metal oxide have also been taken as substrate [9-l3].