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Diamond film, single-layer carbon nanosheet film and diamond/ carbon nanosheet composite film synthesis and field emission performance comparison

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ABSTRACT

A series of diamond films, single-layer carbon nanosheet (SCNS) films and diamond/carbon nanosheet (D/CNS) composite films have been prepared on the heavily-doped n-type silicon substrate by using microwave plasma chemical vapor deposition (MPCVD) techniques and vacuum electron beam evaporation techniques. The films were characterized by field emission scanning electron microscopy (FE-SEM), X-ray diffraction(XRD), Raman spectroscopy. Field emission test results showed that diamond film, SCNS film and D/CNS composite film respective field emission current density is 0.004mA/cm^2 (there's almost no electron emission), 0.45 mA/cm^2 and 3.21 mA/cm^2 at an electric field of 7.2V/μm. This means that the field emission maximum current density of D/CNS composite films is 7.1 times that of SCNS films at an electric field of 7.2 V/μm. At the same time the D/CNS composite film exhibits the advantage of improved reproducibility and long term stability. Diamond layer can effectively improve the field emission characteristics of CNS film. The reason may be due to the diamond film acts as the electron acceleration layer, meanwhile, the heterogeneity of diamond and CNS material could lead to lowering of the interfacial potential barrier.

Keywords: diamond/carbon nanosheets composite film; single-layer carbon nanosheet film; diamond film; field emission; chemical vapour deposition

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