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Superconductivity in CVD Diamond Films

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The recent news of superconductivity 2.3K in heavily boron-doped diamond synthesized by high pressure sintering was received with considerable surprise (1). Opening up new possibilities for diamond-based electrical devices, a systematic investigation of these phenomena clearly needs to be achieved. Application of diamond to actual devices requires it to be made into the form of wafers or thin films. We show unambiguous evidence for superconductivity in a heavily boron-doped diamond thin film deposited by the microwave plasma assisted chemical vapor deposition (MPCVD) method (2). An advantage of the MPCVD deposited diamond is that it can control boron concentration in its wider range, particularly in (111) oriented films. The temperature dependence of resistivity for (111) and (100) homoepitaxial thin films were measured under several magnetic fields. Superconducting transition temperatures of (111) homoepitaxial film are determined to be 11.4K for Tc onset and 7.2K for zero resistivity. And the upper critical field is estimated to be about 8T. These values are 2-3 times higher than these ever reported (1,3). On other hand, for (100) homoepitaxial film, Tc onset and Tc zero resistivity were estimated to be 6.3 and 3.2K respectively. The superconductivity in (100) film was strongly suppressed even at the same boron concentration. These differences of superconductivity in film orientation will be discussed. These findings established the superconductivity as a universal property of boron-doped diamond, demonstrating that device application is indeed a feasible challenge. 1. E. A. Ekimov et al. Nature, 428, 542 (2004). 2. Y. Takano et al., Appl. Phys. Lett. 85, 2851 (2004). 3. E. Bustarret et al., ond-mat 0408517.