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Superconductivity in heavily boron-doped single crystalline and nanocrystalline diamond thin films P. ACHATZ, C. MARCENAT, CEA Grenoble/DRFMC/SPSMS, France, E. BUSTARRET, T. KLEIN, CNRS Grenoble/Institut Neel, France, O.A. WILLIAMS, Institut for Materials Research, Belgium, J.A. GARRIDO, M. STUTZMANN, WSI TUM, Germany — Our results show that the critical boron concentration n_c for single crystalline diamond (scd) and nanocrystalline diamond (ncd) thin films is the same for the normal to superconducting and for the non-metal to metal transitions, on the order of 5×10^{20} cm^{-3}, in agreement with estimates derived from various theoretical approaches. In scd material, a variable range hopping behaviour was clearly observed on the insulating side of the transition, and, as expected, the characteristic temperature T_0 tended toward zero at the transition. On the metallic side, the zero temperature conductivity σ_0 scaled with $(n_B/n_c - 1)^\nu$ with $\nu \approx 1$. The critical temperature T_c remained high in the vicinity of the metal-non metal transition, and it was rather found to scale with $(n_B/n_c - 1)^{1/2}$. These results led us to propose that the electron-phonon coupling parameter λ remains large down to $n_B/n_c \approx 1.1$, and to examine the metal-insulator transition and the parameter set (λ, μ) in terms of scaling laws. Low temperature magnetotransport measurements and the possible occurence of a superconductor-insulator transition in heavily boron-doped ncd will be discussed.

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