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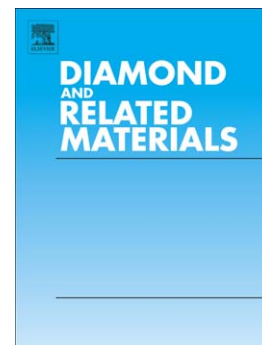
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Heavily phosphorus-doped nano-crystalline diamond electrode for thermionic emission application

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Abstract

Thermionic energy conversion is one of the promising technologies for transforming thermal energy into electrical energy. A stable cathode electrode with high conductivity and low work function is required to realize this application. It is already well known that hydrogen-terminated diamond exhibits negative electron affinity, which is a great advantage of an electron emission electrode. In this study, we focus on phosphorus doping, which gives n-type donors with 0.57 eV in single crystal diamond to control the conductivity of diamond, in an attempt to develop a nano-crystalline diamond (NCD) electrode for thermionic emission by heavily phosphorus doping. Phosphorus concentration and structural characterization were performed by secondary ion mass spectroscopy and Raman spectroscopy, respectively. The thermionic emission properties were characterized in vacuum as a function of cathode temperature from 300 to 600 °C. The work function of heavily phosphorus-doped NCD electrode was estimated based on the Richardson-Dushman equation, and the effect of heavily phosphorus doping on thermionic emission was briefly discussed.

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