SYNTHESIS OF POLYCRYSTALLINE DIAMOND FILMS IN THE ABNORMAL GLOW DISCHARGE AND THEIR PROPERTIES[1]

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Unique chemical, mechanical, electrical and thermal, optical and photoelectrical properties of diamond contribute to its wide application in high–frequency, high–temperature electronics and semiconductor manufacturing of a special purpose [1, 2]. Polycrystalline diamond films (PDF) are successfully used for the production of stable radiation-resistant detectors of UV and ionizing radiation, as well as for laser and photodiode structures [1]. Depending on the characteristics of polycrystalline structure of PDF, the content of alloying impurity atoms and defects, electrical characteristics, as well as the mechanism of the transport and type of the charge carriers vary widely [1]. Among the various PDF deposition methods, there are microwave plasma, hot filament, arc–jet and glow discharge CVD to be marked out. Glow discharge CVD is considered to be an effective diamond film deposition method because of its simplicity and high growth rate [2].

In this work the optical and electrical properties of PDF, deposited from abnormal glow discharge were investigated. Dominant mechanisms of absorption and transport of charge carriers and the energy spectrum of localized defect states which determine the properties of the films were stablished. PDF not inferior to diamond films produced by alternative methods. Parameters of interband absorption and electrical conductivity due to a continuous distribution of energy in the band gap states of defects of different nature. The absorption edge of the crystalline phase is separated from the films of the absorption band due to electronic transitions between localized states defects. Band gap width narrows to 0.2-0.5 eV from the intrinsic value of a diamond. Formed the new edge absorption of films in the energy range 1.2-3.3 eV, where performed Urbach rule and implemented under the direct interband absorption transitions through the optical gap 1.1-1.5 eV. The average width of 2.6-3.24 eV band gap assessment under interband semiclassical model. The relationships between them and the interband absorption due to the exponential static disordering of the crystal lattice. The dominant n-type conductivity activation component is complemented by hopping mechanism involving localized defect states, distributed near the Fermi level with a density of $5.6 \cdot 10^{17}$–2.1×10^{21} $eV^{-1} \cdot cm^{-3}$. Centers of capture and recombination of charge carriers are distributed non-uniformly along the grain boundaries of the film material.

REFERENCES

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