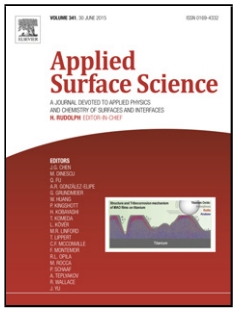

Title: Visible sub-band gap photoelectron emission from nitrogen doped and undoped polycrystalline diamond films

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Visible sub-band gap photoelectron emission from nitrogen doped and undoped polycrystalline diamond films

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Manuscript entitled: "Visible sub-band gap photoelectron emission from nitrogen doped and undoped polycrystalline diamond films" by S.Elfimchev et al.

Highlights

- In this study the origin of visible sub-band gap photoelectron emission (PEE) from polycrystalline diamond films is investigated.
- It was shown that nitrogen related centers in diamond film are mainly responsible for visible sub-band-gap photoelectron emission.
- Our results do not show evidence of the influence of film thickness and substrate on the measured photoelectron emission yields.
- The role of average grain size and defects in diamond film was discussed in this work. We found that nanocrystalline diamonds have low electron emission yields most likely because of high amount of defects, which trap excited electrons before escape into the vacuum and limit the electron emission.
- The increase of visible sub-band gap photoelectron emission with temperature was shown in this work. The phenomenon was explained by the trap assisted photon enhanced thermionic emission model, which takes into account the electron trapping/detrapping processes.

Abstract

In this study the origin of visible sub-band gap photoelectron emission (PEE) from polycrystalline diamond films is investigated. The PEE yields as a function of temperature were studied in the wavelengths range of 360-520 nm. Based on the comparison of electron emission yields from diamond films deposited on silicon and molybdenum substrates, with different thicknesses and nitrogen doping levels, we suggested that photoelectrons are generated from nitrogen related centers in diamond. Our results show that diamond film thickness and substrate material have no significant influence on the PEE yield. We found that nanocrystalline diamond films have low electron emission yields, compared to microcrystalline diamond, due to the presence of high amount of defects in the former, which trap excited electrons before escaping into the vacuum. However, the low PEE yield of nanocrystalline diamond films was found to increase with temperature. The phenomenon was explained by the trap assisted photon enhanced thermionic emission (ta-PETE) model. According to the ta-PETE model, photoelectrons are trapped by shallow traps, followed by thermal excitation at elevated temperatures and escape into the vacuum.