Grand Technion Energy Program

תוכנית האנרגיה ע"ש גרנד

Technion Israel Institute of Technology

תכנית האנרגיה ע"ש גרנד מתכבדת להזמינך להרצאה סמינריונית שתינתן ע"י:

סרגיי ילפימצ'ב

התכנית הבין-יחידתית לאנרגיה

בנושא:

Photo-thermal electron emission from polycrystalline diamond films

Thermionic electron emission (TEE) forms the basis of both electron sources for a variety of applications and a direct energy conversion process that may be compact and scalable. Photon-enhanced thermionic emission (PETE) is a new concept for solar energy conversion based on TEE from semiconductor and allows combining both light and heating of the sun to generate electricity and increases the efficiency of solar power production. Diamond is considered to be one of the most promising materials for electron emission devices due to its outstanding properties. While diamond is a wide band-gap insulator, nitrogen atoms can produce appropriate doping level ~1.7eV below the conduction band minimum. When saturated with hydrogen atoms and properly treated, diamond surfaces are known to exhibit negative electron affinity (NEA) and p-type surface conductivity. Thus, the preparation of nitrogen doped diamond with well-defined hydrogen-terminated surfaces is a pre-requisite for high electron emission.

In this work the impact of substrate temperature during hydrogenation (TH) on TEE was studied from polycrystalline hydrogenated diamond film deposited by hot filament chemical vapor deposition (HF CVD) method. For hydrogenation at low substarte temperature the TEE was found to display a broad maximum at substrate temperature around 300 °C. Annealing at 700 °C results in irreversible changes in surface conditioning, and drastic reduction of TEE yield at low temperatures. We associate these effects with irreversible thermal induced physicochemical changes of the hydrogen bonding configuration adsorbed on the polycrystalline diamond surface resulting in changes in its surface electronic structure.

Photon electron emission (PEE) from poly-diamond films was investigated. The onset for PEE was found at about 550 nm and PEE intensities increases strongly with photon energy. The influence of temperature on PEE was studied and the synergetic effect of light and heat on electron emission from poly-diamond films was observed and explained. The synergetic effect of photo-thermal electron emission (PTEE) may be rationalized as a combined three-step process: 1) photon excitation of electrons to the conduction band 2) electron-phonon scattering and recombination processes; 3) thermal excitation from near conduction band trap levels into vacuum. The influence of surface morphology on TEE and PTEE was also examined. The engineering of poly-diamond electron emission properties is seems to be possible.

מנחה: פרופ' אלון הופמן, הפקולטה לכימיה ע"ש שוליך

במסגרת עבודת מחקר לתואר מגיסטר

ההרצאה תתקיים ביום ג' 13.1.15 בשעה 12:30 בחדר הסמינרים, בניין הפקולטה לכימיה

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