OR2602

Iron doped tetrahedral amorphous carbon thin films by filtered cathodic vacuum arc for electrochemical sensing applications

Jarkko Etula, Niklas Wester, Sami Sainio, Tomi Laurila, Jari Koskinen

Aalto University, Espoo, Finland

jarkko.etula@aalto.fi

The development of new electrode materials for in vivo and in vitro detection of neurotransmitters and active pharmaceutical ingredients, such as opioids, is becoming increasingly important. Here, pulsed filtered vacuum arc process is used to investigate the effect of iron doping in tetrahedral amorphous carbon (ta□C) thin films, to be used as electrodes in the electrochemical detection of drugs.
As of yet unreported iron-doped ta-C thin films (Fe/ta-C) are co-deposited with 2, 5 and 10 at% iron using a dual-source filtered cathodic vacuum arc process at room temperature. The versatile dual-source vacuum arc setup enables control over the metal content in the carbon or metal matrix, providing the means for the tailoring of application-specific thin films for different sensor applications. Deposited films are examined extensively using physical film characterization methods combined with electrochemical techniques.
Tetrahedral amorphous carbon thin films have been shown to perform well in these electrochemical detection applications, and although facile electron transfer has been achieved for ultrathin 7 nm thick ta-C electrodes, such films commonly suffer from pinholes on various electrode surfaces. On the other hand, thicker ta-C films can be too resistive for sensor applications. Here, even the smallest addition of 2 at% iron in 30 nm ta-C thin films is found to dramatically decrease sheet resistance and re-enable this facile electron transfer, while preserving the desired sensor properties. Overall, significant improvements to the electrical and electrochemical properties of the material are achieved by iron doping. As a result, Fe/ta-C films outperform reference ta□C films in the drug detection application.

Keywords
iron/ta-C composite
PVD
sensor
electrical
electrochemical