DIAMOND-LIKE CARBON FILMS APPLIED IN ELECTRONIC DEVICES

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This work presents studies on application of diamond-like carbon (DLC) thin films in such electronic devices as field electron emitters and detectors of hydrogen and its compounds. The DLC films were deposited by radio-frequency plasma-enhanced chemical vapour deposion (RF PECVD) method on silicon substrates.

In case of the electron emitters the DLC films were applied as emitting layer or as an interfacial layer for carbon nanotube-based devices. We studied here an influence of the deposition parameters on functional properties of the devices. Atomic force microscopy and Raman Spectroscopy were used for investigation of physical and chemical properties of the deposited DLC films. Moreover, measurements of the field emission were performed. It was found that for samples deposited with self-bias voltage lower than 280 V, the emission at lower electric field was insignifficant. On the other hand when the self-bias voltage was 280 V or higher, there was obtained stable emission current and repeatable results. When electric field reached E=130 V/μm the carbon films lost their adhesion to the substrate and delaminated next.

In case the hydrogen and its compounds detectors, we studied an influence of a presence of DLC interfacial layer on adhesion of nanocomposite carbonaceous film containing palladium nanograins. The Pd-containing films were obtained by physical vapour deposition method and then modified by a following deposition of the DLC films. Moreover, an influence of an annealing process on morphology of the films was investigated. These properties of the films were studied with scanning electron microscope working in two modes, i.e., scanning electron and low-angle backscattered electron mode. It was found that the carbon nanocomposite films containing palladium nanograins obtained on Si substrate have lower roughness than film deposited on Si substrate covered with the DLC layer. After the RF PECVD modification, the roughness increased and Pd grains of up to hundred nm in diameter were found on the film surface. Presence of carbon shells covering these nanocrystals could be also observed. The thermal annealing of the carbon nanocomposite films containing Pd nanograins also led to the a modification in film topography and to agglomeration of small nanocrystals of Pd into bigger objects protruding from the film surface. The mentioned above modification in film morphology is foreseen to be very important factor in sensitivity of the devices to hydrogen.

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