Nano-diamond based materials fabrication with low pressure non-equilibrium microwave gas discharge and its field emission properties

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Low pressure ethanol non-equilibrium gaseous MW discharge properties were studied for their impact upon self-assembly of nano-crystalline diamond clusters embedded into graphite and polymer-like films. Carbon based nano-structured films were fabricated and possibility of their properties control was demonstrated. It was demonstrated that process can provide a control of diamond nano-cluster's surface concentration within the range from 0.05×10^8 cm^{-2} up to 1.4×10^8 cm^{-2} and cluster's linear dimensions within the range 10–120 nm [1, 2].

Correlation of diamond-graphite films crystalline nanostructure, film component phase ratio and electron transport and field emission mechanism was studied. Feasibility of film nanostructure optimization in respect of field emitters was demonstrated along with the setting of appropriate criteria.

Fabricated with diamond-graphite cathodes integrated diode array samples demonstrated emission current density up to 2.0 A/cm². Such a result exceeds emission currents obtained with carbon nanotube based cathode arrays. Applied voltage was within the 5-10 V, that provided electric field about 2.5–5.0 V/μm for vertical integrated diode design. For lateral emitters emission current density of 20 A/cm^2 was obtained with 300V voltage applied.

[1] R.Yafarov, V.Moullin, V.Semenov, RUS Patent 2302369 dated 10.07.2007. A method for nano-diamonds fabrication embedded in polymer-like carbon-hydrate matrix.

[2] R.Yafarov, V.Moullin, V.Semenov, RUS Patent 2309480 dated 27.10.2007. Material and method for multi-spike field emission cathode fabrication.