Nanocrystalline diamond clusters for field electron emitter

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Recent years the intensive researches of the cold electron emitters based on carbon clyster materials (nanotubes and diamond-like films) take place. The reason for these is a dramatically low value of the threshold electric field of vacuum electron emission in such materials. This fact determines the possibility of applying them for cold cathodes in flat electro luminescence displays and light sources. The main problem of the flat field emitters remains the non-uniformity of the emission current concerned with concentration of the emission current into the randomly distributed "emitting sites" – points of high emission current density.

As a solution of this problem we propose to form the structure with controlled emitting site distribution based on the detonation – synthesised nanocrystalline diamond (NCD).

According to the results of our recent works this material consists of perfect crystalline diamond clusters with extremely narrow size distribution 45 ± 3 angstroms. Each diamond nano crystal has a conductive onion-like shell of sp2 – bonded (like graphite) carbon.

The structure of NCD based flat field emitter consists of amount of separate clusters placed on fine surface of carbide forming metal (nickel, wolfram) or semiconductor silicon. Such structure allows each cluster on the surface to be the detached emitting site.

We developed the technique for emitter structure preparation by electrophoresis in non-conductive solvent. For separation of clusters, we use the shock wave treatment of NCD suspension in solvent. To control the conductance of cluster shell we use high temperature annealing of the prepared structures. To enhance the applied field we used the nickel tip arrays as substrates. To prepare such arrays we used the ion-track membrane technology. We deposited NCD clusters on the top of the tips.

The program «Low dimensional quantum structures» of the Russian Academy of Sciences supported this work.