Rich-diamond and rich-graphite nanodiamond particles

G. Palazzo,¹ L. Velardi², A. Valentini³ and G. Cicala²

¹Chemistry Department, University of Bari, Bari, Italy
²CNR-NANOTEC Sezione of Bari,
³Physics Department, University of Bari

*gerardo.palazzo@uniba.it

Nowadays, nanodiamond (ND) particles are attracting increasing interest for their outstanding properties of the diamond and are excellent candidates for many and disparate applications in the fields of: drug delivery carriers, bio-labelling probes, nanocomposites, single photon sources, electrochemical energy storage, nucleation sites for growth of high performance CVD nanocrystalline diamond films, highly efficient and stable photocathodes [1], just to cite a few. Usually, the nanoparticles exhibit a very high surface-to-volume ratio and therefore they got surface-dependent properties more significantly than their bulk counterparts and tuneable with treatments. For the above applications, the ND particles are generally handled in colloidal dispersion and their behavior in solution is critical. In particular, as received particles with size of few nanometers are hardly separate in monodisperse particle colloids, but high temperature treatment in H₂ gas or air makes easy to get monodispersion and stability.

In this contribution, we present an investigation on two types of ND powders with particle size of about 250 nm and having different sp² (graphite phase) and sp³ (diamond phase) carbon contents; for this the powders are classified as rich-diamond and rich-graphite nanodiamonds. The surface of ND particles has been modified with treatment in H₂ microwave plasma. The presence of hydrogenated surface affects in the solid state the quantum efficiency of ND-based photocathodes [1] and in solution the particle zeta potential and therefore their stability [2].

Many aqueous dispersions were prepared with the two types of powders, as received (ND as-rec) and hydrogenated (H-ND). The more concentrated (1 mg/1 ml) were used to produce photocathodes whose ND layers were deposited by pulsed spray technique [1], whereas more diluted (0.1 mg/1 ml) were examined by dynamic light scattering in the pH range from 2 to 12.

The effect of the hydrogen treatment is beneficial inducing an increase of photocathode quantum efficiency and a correspondent increase of the zeta potential (see Fig. 1).

The ND particles were also characterized by Raman and FTIR spectroscopies, and transmission electron microscopy.

![Fig. 1 Zeta potential of untreated and hydrogenated nanodiamond powder as a function of pH.](image)

**Acknowledgements** The financial support of the Project PON03PE_00067_6 “APULIA SPACE”, (Italy) is partially is acknowledged.