Manufacturing of seeding suspensions based on crushed nanodiamond for CVD diamond films

Stepanenko E.V.*[1], Levashov E.A.[1], Ralchenko V.G.[2], Patsera E.I.[1]

[1]*National University of Science and Technology "MISIS", 119049, Moscow, Russia*
[2]*A.M. Prokhorov General Physics Institute RAS, 119991, Moscow, Russia*
**e-mail: ev_azarova@mail.ru*

Growth of diamond films on a foreign substrate using a CVD process typically requires surface treatment in order to achieve a high nucleation density. One of the most widely used approaches is seeding of the substrate with diamond particles through the use of a slurry of diamond particles with grain size from nanometers to microns dispersed in an appropriate solvent (alcohol, acetone, etc.) accompanied by ultrasonic agitation [1]. Slurries of nanodiamond provide the highest nucleation density.

In this work we employed narrow distributed diamond powder MD20 with the average grain size 20 nm produced by a technique of crushing after static conversion from graphite ("Tomei Diamond Inc., Ltd", Japan) for preparing the diamond slurries. MD20 powder was dispersed in an ultrasonic horn-type ultrasound sonicator UZDN-2T with an output power of 400 W. Water and isopropyl alcohol were used as a solvent. Diamond suspensions were sonicated with the frequencies of 22 and 44 kHz and processing time from 5 to 60 minutes. The suspension of MD20 with isopropyl alcohol were compared to disaggregated detonation nanodiamond with average grain size 4 nm in a water solvent (supplied by Ioffe Physical-Technical Institute of Russian Academy of Science). Si wafers were seeded by sonication in a nanodiamond suspension. After 30 min of sonication, the substrates were removed and rinsed with water or isopropyl alcohol.

Particle size distributions in suspensions were measured by photon correlation spectroscopy (PCS) using a Beckman–Coulter N5 submicron particle size analyzer. Seeded Si substrates were observed with scanning electron microscopy.

As a result the relatively stable suspension of MD20 diamond powder in isopropyl alcohol with average particle size 20 nm has been obtained. Nucleating density on Si substrate was 10^9 cm^{-2}. In the case of water suspension the cleaning of Si surface is required as an additional step for liquid spreading and uniform particles distribution on the surface.

[1] Shenderova O., Hens S., McGuire G., *Diamond and Related Materials* **19**(2-3), 260 (2010).