

## The nucleation and growth of nanocrystalline diamond films in millimeter-wave CVD reactor

Chernov V.V.<sup>1</sup>, Vikharev A.L.\*<sup>1</sup>, Gorbachev A.M.<sup>1</sup>, Kozlov A.V.<sup>1</sup>, Vul' A.Ya.<sup>2</sup>, Aleksenskii A.E.<sup>2</sup>

<sup>1</sup>*Institute of Applied Physics RAS, Nizhny Novgorod, Russia*

<sup>2</sup>*Ioffe Physical-Technical Institute RAS, St. Petersburg, Russia*

\*e-mail: val@appl.sci-nnov.ru

Nanocrystalline diamond films grown by CVD technique possess a number of unique properties. This makes it possible to use them in thermal management, electromechanical, microelectronic, optical, biological and many other scientific and industrial applications [1]. Due to these reasons the interest for the investigation and application of nanocrystalline diamond films has grown considerably in recent years.

An important role in deposition of uniform smooth nanocrystalline diamond films is played by the prior preparation of the substrate, the choice of the diamond nuclei and the method of its seeding on the substrate. In our experiments the diamond nuclei were particles of detonation nanodiamond [2] seeded on the substrate from suspension. The diamond powder from the suspension was deposited on the substrate by using the spin coating process. This method ensures the same uniform and high-density deposition of the diamond powder on the substrate as in the case of the ultrasonic bath, while the consumption of the nanopowder is lower.

Nano-diamonds of two types were prepared for the experiments on deposition of nanocrystalline diamond films, namely, those having the average sizes of nanoparticles 4 nm and 40 nm, correspondingly. Seeded by the spin coating silicon substrates having a diameter of up to 100 mm and nucleation density ranging from  $10^{10}$  to  $10^{12}$  cm<sup>-2</sup> were put into the chamber of millimeter-wave CVD reactor [3] filled with the Ar-H<sub>2</sub>-CH<sub>4</sub> mixture. As a result uniform smooth nanocrystalline diamond films with thicknesses of several hundreds of nanometers were obtained. Properties of the nanocrystalline diamond films were compared for two types of used seeding suspension.

- [1] O.A. Williams, M. Nesladek, M. Daenen, S. Michaelson, A. Hoffman, E. Osawa, K. Haenen, R.B. Jackman, *Diam. Relat. Mater.* **17**, 1080 (2008).
- [2] A.Ya. Vul', A.E. Aleksenskiy, A.T. Dydaikyn Detonation nanodiamonds: technology, properties, and applications. In the book «Encyclopedia of systems of life support» Nanoscience and nanotechnology, pp. 832-857 (2009).
- [3] A.L. Vikharev, A.M. Gorbachev, A.V. Kozlov, D.B. Radishev, A.B. Muchnikov, *Diam. Relat. Mater.* **17**, 1055 (2008).