Nanostructured surfaces

Formation of nanocolumnar carbon nitride structures by cluster magnetron deposition

M.I. Mokhnenko, V.N. Varyukhin, A.M. Prudnikov

High Pressure and Advanced Technology Department, Donetsk Institute for Physics and Engineering named after O.O. Galkin, R. Luksemburg str., 72, Donetsk, Ukraine
E-mail: marya.mohnencko@yandex.ua

Carbon nitride compounds have been found to exhibit very interesting properties, such as high hardness combined with extreme elasticity. The nanostructure carbon nitride has various applications such as hydrogen power production, micro- and optoelectronics, tribological coatings, etc. An essential feature of magnetron charge is specific nature of magnetron plasma, which is determined by processes involving electrons, atoms and clusters [1].

Research methods applied were scanning electron microscopy (SEM), transmission electron spectroscopy (TEM), atomic force microscopy (AFM).

Carbon nitride films were produced by magnetron sputtering of the graphite target onto a quartz glass substrate. The discharge power of the magnetron, during the sample production, did not exceed 20.0 W. The gas pressure inside the chamber was 26.0 Pa.

Depending upon the substrate temperature and nitrogen concentration in the growth atmosphere we obtained the following types of structures:

- an amorphous phase($T_S \leq 100$ °C);
- a graphitelike phase ($T_S \geq 250$ °C, C_N ~8 at. %) [2];
- a nanocolumnar structure (T_S~ 100 – 240 °C, C_N ~4 - 10 at. %);
- a fullerenelike structure (T_S~100 - 350 °C, C_N ~12-22 at. %).

The diagram for the structures observed in sputtered CN_x films at different substrate temperatures T_s and nitrogen concentrations C_N . was built. The cluster nature of carbon nitride film formation by magnetron sputtering was established. Experimental data and analytical cluster radius estimations are found to be in good agreement.

1. *Смирнов. Б.М.* Магнетронная плазма и нанотехнология //УФН. – 2007. – Т.170 (5). – С.473-510.
2. *Shalaev R.V., Ulyanov A.N., Prudnikov A.M., Shin G., Yoo S., Varyukhin V.* Noncatalytic synthesis of carbon-nitride nanocolumns by dc magnetron sputtering // Phys. Status Solidi A. – 2010. –**207,** №10– P 2300–2302.