

PROPERTIES OF ULTRANANOCRYSTALLINE DIAMOND GROWN UNDER DIFFERENT DEPOSITION CONDITIONS*

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Diamond films have many industrial applications due to the combination of unique physical and chemical properties. One important concern of diamond films deposition is achieving a good adhesion to the substrate, which depends on residual stresses in the film after deposition. Other important concerns of deposition are achieving good mechanical properties comparable with a single-crystal diamond, as well as fine structure and surface parameters. Ultrananocrystalline diamond (UNCD) films have a grain size in the range of 5–10 nm and smooth surface in comparison with micro- and nanocrystalline diamond films.

We synthesized UNCD films on Si substrates by hot filament chemical vapor deposition method with different methane concentrations (up to 24 vol. %) in the gas mixture and the deposition pressure at 20 Torr. To characterize obtained films we used Raman spectroscopy, XRD analysis, profilometer measurements, AFM to estimate surface roughness, nanoindentation tests were performed to obtain hardness and Young's modulus.

Figure 1 shows results of nanoindentation test and residual stress estimation.

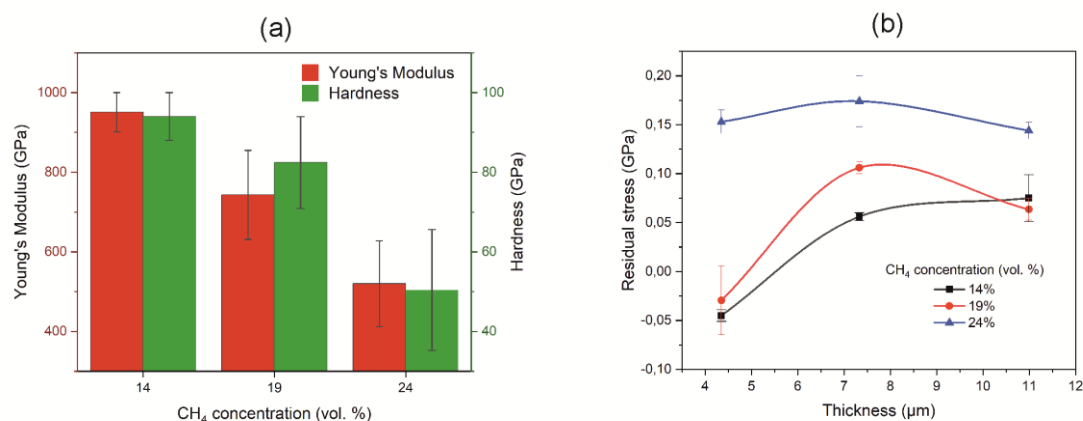


Fig.1. Data for (a) hardness and Young's modulus, and (b) residual stress.

Results from fig. 1. (a) shows that with increase in the methane concentration hardness and Young's modulus decrease. Young's modulus of a material correlates with a concentration of defects in it [1], and in this case grain boundary content acts as a defects. As can be seen from fig. 1 (b) with increase in the methane concentration, tensile stress increases. This is due to increase in non-diamond phase and grain boundary content, because accordingly to [2] increase in defect concentration leads to rise in tension stress.

This research is planned to be one in the series of works devoted to application of UNCD coatings for cutting tools.

REFERENCES

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