Synthesis of nanostructured amorphous carbon-copper composite films

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Recently, considerable attention is given to research of carbon films with metal impurities and various carbon nanostructures, obtained using metal catalyst [1-4]. The copper is one of the most popular metals used in the formation of carbon composites or nanostructures (graphene, carbon nanotubes) due to low solubility of carbon in copper, low cost, and availability [2-4].

The copper nanolayer film of 20 ± 5 nm thickness was formed on Si (100) substrates by magnetron sputtering. Nanostructured amorphous carbon layers were deposited by plasma-enhanced chemical vapour deposition. The formation was done on copper-silicon substrates at 25 °C, 300 °C, 520 °C, and 700 °C temperatures using an acetylene gas at 40–70 Pa pressure. The heating of the Cu/Si substrate induced formation of Cu nanospheres with 50–500 nm size depending on the substrate temperature. The microstructure and composition of nanostructured carbon-copper composite films were investigated. The scanning electron microscope views showed growth of amorphous carbon films with the randomly distributed nanostructures. The oxygen concentration decreased from 10.7 at.% to 3.2 at.% with the increased heating temperature. The index of refraction decreased from 2.15 to 1.68 with the increase of the temperature from 25 °C to 700 °C. The surface roughness measurements indicated that the surface roughness values increased with the increase of the temperature. The increase of the substrate temperature stimulated to the graphitization, enhanced the fraction of sp^2 C=C sites and lead to the formation of the nanocrystaline graphite clusters in composite. The nanohardness values of the formed nanostructured amorphous carbon-copper films varied in the range of 0.2–3 GPa.

References

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