Formation of amorphous carbon films and nanostructures at atmospheric pressure

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Amorphous carbon films and nanostructures (nanotubes, graphene, glassy carbon, carbon black, nanocrystallites and etc.) have received considerable attention due to their unique thermal, mechanical, chemical, optical and electrical properties. These fascinating properties make the amorphous carbon films and nanostructures promising candidates for the application in a wide variety of fields such as electronics, optics, biochemical, biomedical, and etc. [1-3].

Carbon films were deposited on the silicon-gold substrates at atmospheric pressure using a linear direct current plasma torch. A thin gold (~20 nm) layer was deposited on Si substrate by magnetron sputtering technique. Argon or argon-hydrogen mixture were the plasma forming gases. Acetylene (C_2H_2) gas was used as carbon source with 0.044, 0.033, and 0.026 l/min flow rates. The substrates were chemically cleaned by acetone and 30-60 s purified in the argon or argon-hydrogen plasma before starting the deposition process. Surface morphology was analyzed by scanning electron microscopy (SEM). The bonding structure was investigated by Raman scattering (RS) spectroscopy and Fourier transform infrared (FTIR) spectrometer. The SEM measurements indicated that the films deposited without the hydrogen at higher temperatures are rough and consist of columnar structure. The columns size decreased with decreasing C_2H_2 flow rate. The RS results indicated that the deposited films are graphite-like carbon films with glassy carbon phase and graphite micro/nano-crystallites. The introduction of the hydrogen lead to the formation of the nanocrystalline graphite films or stipulate growth of micro and nanosize carbon clusters depending on the hydrogen and acetylene ratio.

References

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