



Iranian Journal of Physics Research, Vol. 24, No. 4, 2025
DOI: 10.47176/ijpr.24.4.51891

Investigating the effect of RF power in dual cathode plasma magnetron sputtering on the optical, structural, and electrical properties of Cu-DLC thin films

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(Received 04 May 2024 ; in final form 11 August 2024)

Abstract

In this paper, the structural, electrical, and optical properties of copper-doped amorphous carbon films were investigated and the relation of these properties with a plasma-produced chemical active species in simultaneous direct current and radiofrequency magnetron sputtering was studied. The effect of changing the power of a direct current power supply at constant power of radio frequency on the film properties was investigated. Raman spectroscopy of the films indicated that the G peak position and ID / IG ratio increased, which indicates a decrease in the SP³ bonding in the film structure. Optical emission spectroscopy (OES) was also performed to investigate the dominant chemical active species produced in the plasma environment and showed that Cu active species decreased with increasing power. Also, the results showed that by increasing the power of direct current to the graphite target from 60 to 120 W as well as keeping the radio frequency power constant at 10 W which connected to copper target, the optical absorption coefficient of the films increased. Also, the optical band gap grew from 0.92 eV to 1.5 eV. The refractive index of the deposited films analyzed by ellipsometry showed a decreasing trend from 1.85 to 1.24 with increasing power.

Keywords: diamond-like carbon, copper particles, radio frequency magnetic sputtering and simultaneous direct current, Raman spectroscopy, ellipsometric spectroscopy, refractive index

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