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The comparative study of pure and pulsed DC plasma sputtering for synthesis of nanocrystalline Carbon thin films

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Nanocrystalline Carbon thin films have numerous applications in different areas such as mechanical, biotechnology and optoelectronic devices due to attractive properties like high excellent hardness, low friction coefficient, good chemical inertness, low surface roughness, non-toxic and biocompatibility. In this work, we studied the comparison of pure DC power and pulsed DC power in plasma sputtering process of carbon thin films synthesis. Using a close field unbalanced magnetron sputtering system, films were deposited on glass and Si wafer substrates by varying the power density and pulsed DC frequency variations. The plasma characteristics has been studied using the I-V discharge characteristics and optical emission spectroscopy. The films properties were studied using Raman spectroscopy, Hall effect measurement, contact angle measurement. Through the Raman results, ID/IG ratio was found to be increased by increasing either of DC power density and pulsed DC frequency. Film deposition rate, measured by Alpha step measurement, increased with increasing DC power density and decreased with pulsed DC frequency. The electrical resistivity results show that the resistivity increased with increasing DC power density and pulsed DC frequency. The film surface energy was estimated using the calculated values of contact angle of DI water and di-iodo-methane. Our results exhibit a tailoring of surface energies from 52.69 to 55.42 mJ/m^2 by controlling the plasma parameters.

Keywords: nanocrystalline carbon thin films, pure DC plasma, pulsed DC plasma, unbalanced magnetron sputtering