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Film deposition on inner surface of tubes using atmospheric pressure argon-acetylene and argon-acetylene-hydrogen plasmas: Interpretation of film properties from plasma-chemical kinetics

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Hard amorphous hydrocarbon film is deposited on inner surface of glass tubes using filamentary discharge at atmospheric pressure in Ar-C_2H_2-H_2 mixture. Under similar condition, soft film is deposited with high film deposition rate in Ar-C_2H_2 plasma. These differences in film hardness and deposition rate are interpreted on the basis of carbon and hydrogen elemental composition in the plasma systems. Film deposited using Ar-C_2H_2-H_2 mixture shows properties similar to the one deposited using Ar-CH_4 mixture. Film deposition rate is varied along the axis of tubes in Ar-C_2H_2-H_2 mixture. This variation profile can be controlled by controlling the substrate (tube) temperature. Etching efficiency of loosely held carbon with reactive hydrogen atom is studied by varying substrate temperature, and concluded that increasing substrate temperature increases the etching rate. Plasma-chemical kinetics of precursors dissociation and follow-up plasma-chemical reactions are simulated for our experimental conditions using determined plasma parameters. Simulated results are correlated with determined film properties. Plasma parameters are determined using time and space resolved optical emission spectroscopy and laser absorption spectroscopy. Furthermore, the discharge is simulated using nonPDPSIM, which is provided by Mark Kushner. This software allows simulation of discharges at atmospheric pressure and takes the propagation through streamers into account. Discharge parameters like reduced electric field, charged particle densities and electron temperature are simulated and compared to measured data.

References:
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Keywords
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