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Abstract

Amorphous silicon carbonitride thin films for biomedical applications were deposited in an industrial coating unit from a silicon target in different argon/nitrogen/acetylene mixtures by reactive high power impulse magnetron sputtering (rHiPIMS). The effects of acetylene (C_2H_2) flow rate, substrate temperature, substrate bias voltage, and HiPIMS pulse frequency on the film properties were investigated. Low C_2H_2 flow rates ($<$ 10 sccm) resulted in silicon nitride-like film properties, seen from a dense morphology when viewed in cross-sectional scanning electron microscopy, a hardness up to $\sim$ 22 GPa as measured by nanoindentation, and Si–N bonds dominating over Si–C bonds in X-ray photoelectron spectroscopy core-level spectra. Higher C_2H_2 flows resulted in increasingly amorphous carbon-like film properties, with a granular appearance of the film morphology, mass densities below 2 g/cm^3 as measured by X-ray reflectivity, and a hardness down to 4.5 GPa. Increasing substrate temperatures and bias voltages resulted in slightly higher film hardnesses and higher compressive residual stresses. The film H/E ratio showed a maximum at film carbon contents ranging between $15 - 30$ at.% and at elevated substrate temperatures from 340 ℃ to 520 ℃.

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