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Optical properties of a-SiC:H films deposited by continuous wave and pulsed plasmas

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Thin films in a form of hydrogenated amorphous carbon-silicon alloys (a-SiC:H) can be prepared from organosilicon monomers using plasma-enhanced chemical vapor deposition (PECVD). The a-SiC:H films may have various optical properties with application potential. Optical films of controllable properties are essential for optical and optoelectronic devices as barrier, anti-scratch, biocompatible, transparent, antireflective, or dielectric coatings, and optical filters. We deposited a-SiC:H films from tetravinylsilane monomer at different powers using continuous wave (10-70 W) and pulsed (2-150 W) plasmas (PECVD). In situ phase-modulated spectroscopic ellipsometer (UVISEL, Jobin-Yvon) was used to determine the film thickness and optical properties (refractive index, extinction coefficient) ranging 250-830 nm. The deposition rate for a-SiC:H films varied from 82 to 262 nm/min as a function of power and was compared for continuous wave and pulsed plasmas. The dispersion curves for refractive index and extinction coefficient were observed for films deposited at different powers. The refractive index for a selected wavelength of 633 nm increased from 1.7 to 2.3 with enhanced power. The UV absorption of a-SiC:H films increased for higher powers and the extinction coefficient at 633 nm was ranging from 0 to 0.15 with enhanced power. The dispersion dependence of the dielectric function was fitted by the Tauc-Lorentz formula to determine the band gap that decreased from 2.7 (2 W) to 0.7 eV (150 W). The developments of optical properties with power were similar for continuous wave and pulsed plasmas.

Keywords
PECVD
Spectroscopic ellipsometry
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Extinction coefficient
Band gap