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13.56 MHz Hollow Cathode Plasma Source HCD-P 100 in a PlasCon HCD plasma system

Fig. 1: PlasCon HCD

Pulsed PECVD deposition of diamond-like carbon films

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The work described below was performed using a PlasmaConsult HCD-P 100 hollow cathode plasma source in a PlasCon HCD plasma system.

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Pulsed PECVD deposition of diamond-like carbon films

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Abstract

Diamond-like carbon (DLC) films were deposited in a RF–RF plasma system employing a radio frequency (RF) powered substrate holder with an additional RF (13.56 MHz) driven, planar hollow cathode discharge (HCD-P) plasma source. Typically, the HCD plasma source was operated at 400 W (cw). To control the film properties as well as the balance of film deposition and simultaneous etching, the substrate holder power was modulated with a frequency of 100 Hz. The duty cycle was varied between 20 and 100% while keeping the time-averaged power fixed at 240 W. A mixture of argon, helium (1:1) and acetylene were used as carrier gases and carbon source, respectively. The influence of the duty cycle applied to the substrate holder on the deposition process and film quality were investigated by Raman spectroscopy, Fourier transform infrared (FTIR), ellipsometry and nanohardness measurements. All films show a broad Raman peak, centered at approximately 1530 cm^{-1} (G-peak), as well as a lower frequency shoulder at approximately 1350 cm^{-1} (D-peak), a feature typical for DLC films. Refractive indices between 2.1 and 2.2 (at λ=632 nm) were measured. A nanohardness of up to 17.5 GPa has been obtained. Although the deposition rate increases with increasing duty cycle, it does not scale linearly. Even at duty cycles ≤50% deposition rates of approximately 100 nm/min were obtained, compared to 130 nm/min for cw operation of the substrate holder. Furthermore, we found that pulsed PECVD of DLC films

APPLICATION NOTE

HCD-P 100/ PlasCon HCD

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reduces the compressive stress and improves adhesion, e.g. on stainless steel substrates.

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Fig. 2: HCD-P 100

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