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PlasCon HCD 13.56 MHz Hollow Cathode System

Fig. 1: PlasCon HCD

Diamond-like carbon film deposition by a 13.56 MHz hollow cathode RF-RF system using different precursor gases

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The work described below was performed using a PlasmaConsult PlasCon HCD hollow cathode plasma system.

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Abstract

Diamond-like carbon films (DLC) were deposited in a novel 13.56 MHz RF-RF system (Plasma Consult GmbH PlasCon HCD-System) at a substrate temperature of 60°C. Typically, a radiofrequency (RF) power of 400 W was used for plasma generation by a hollow cathode discharge plasma source (HCD). The substrate holder was also RF powered and had a negative DC self bias voltage in the range of 200-600 V. Both HCD and the RF-substrate holder arc run with synchronized RF-power generators and automated impedance matching units. The carrier gas He was introduced into the primary hollow cathode discharge at a flow rate of typical 400 seem. Methane and acetylene were used as a carbon source at flow rates between 15 and 100 seem. An ion concentration of up to 2 × 10[11] cm [-3] was measured in the plasma with a HCD and RF bias on. Without the HCD an ion concentration of approximately 5 × 10[10] cm[-3] was achieved. Higher ion concentration had a positive influence on the deposition process and allowed to achieve a higher deposition rate. In the stationary mode deposition rates of 70-80 nm min[-1] with methane as a precursor gas and 180-260 nm min[-1] with acetylene as a precursor gas were measured. The films were investigated by micro-Raman spectroscopy, FTIR, ellipsometry and microhardness measurements. It was found that even in the stationary mode deposition the film thickness variations across a 5 Si-wafer were lower than ± 3.5%. The acetylene based DLC films have a refractive index of 2.1-2.15 at wavelength of 632 nm. The refractive

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index of DLC films, deposited with methane as a precursor, was between 2.2 and 2.3. Vickers microhardness of these films of up to 30 GPa were achieved.

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