

## 13.56 MHz Hollow Cathode Plasma Source HCD-L 300 & HCD-P 100

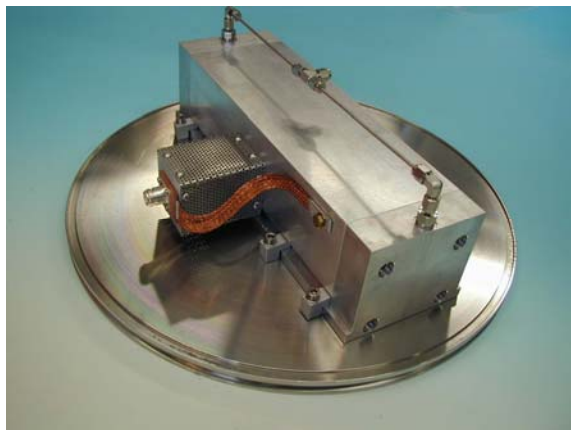


Fig. 1: HCD-L 300

### Deposition of diamond-like carbon films by a hollow cathode multi-jet rf plasma system

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The work described below was performed using PlasmaConsult HCD-L 300 and HCD-P 100 hollow cathode plasma sources.

G. Fedosenko, J. Engemann and D. Korzec  
*Deposition of diamond-like carbon films by a hollow cathode multi-jet rf plasma system*  
Microstructure Research Center-fmt, University of Wuppertal, Germany

### Abstract

Diamond-like carbon (DLC) films were deposited on silicon and polycarbonate substrates with diameters up to 5 inches. Deposition temperatures and negative rf-bias were 60°C and 250–450 V, respectively. The central part of the deposition system is a novel scaleable 13.56 MHz rf hollow cathode multi-jet plasma source operating typically at 400 W and a pressure of 100 Pa. He was used as carrier gas in

the primary hollow cathode discharge with a standard flow of 400 sccm. Downstream from a second gas distribution level close to the primary plasma outlet, methane (CH<sub>4</sub>) and acetylene (C<sub>2</sub>H<sub>2</sub>) serving as the carbon supply were effectively dissociated and activated. The measured maximum ion concentrations depend on the systems operation mode. When powering the substrate holder only, up to  $4.7 \times 10^{10} \text{ cm}^{-3}$  ions were measured. Simultaneous operation of the hollow cathode plasma source and powering of the substrate holder, however, increases the ion density up to  $2 \times 10^{11} \text{ cm}^{-3}$ . As expected, high ion concentrations yield high deposition rates with 70–80 and 160–200 nm min<sup>-1</sup> for methane and acetylene (stationary deposition mode), respectively. The DLC films were characterized by micro-Raman spectroscopy, ellipsometry and microhardness measurements. It was found that even in the stationary deposition mode, film thickness variations across a 5-inch wafer did not exceed  $\pm 3.5\%$ . The highest deposition rate and best film quality were obtained at a substrate holder bias of -350 to -420 V. Methane-derived films showed refractive indices ranging from 2.1 to 2.3 at 632 nm and a Vickers microhardness of up to 30 GPa.

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Fig. 2: HCD-P 100

For further information please contact:

Plasma Consult

**JE PlasmaConsult GmbH**  
**Rainer-Gruenter-Str. 21, Geb. FN**  
**42119 Wuppertal**  
**Germany**

Tel. ++49-202-28397-0  
Fax ++49-202-28397-123  
contact@plasmaconsult.de  
www.plasmaconsult.com