DLC coatings were prepared using the RF powered cylindrical and linear hollow cathodes. The deposition process is hybrid, combining both the PE CVD and PVD. A cylindrical graphite nozzle and graphite plates were used as targets. The gas mixture used in the deposition process was argon with acetylene. Compared to e.g. magnetron sputtering, the optimum content of acetylene is lower. The effect of the acetylene content in the gas mixture as well as RF power on the deposition rate and properties of the coatings are evaluated.

The geometrical effect is studied, the cylindrical hollow cathode and the linear hollow cathode are compared and the transfer of the optimized process from the cylindrical into the linear hollow cathode is discussed.

**Methods**

**Cylindrical**
- Target material: Graphite
- Substrate: Glass plate and Si wafer
- RF power: 13.56 MHz
- The gas mixture: Ar/C₂H₂

A cylindrical RF electrode with a graphite nozzle for generation of an active plasma jet channel
- Inner diameter: 3 mm
- RF: 13.56 MHz
- Power: <500 W
- Bias: 0 W

**Linear**
- Target material: Graphite
- Substrate: Glass plate and Si wafer
- RF power: 13.56 MHz
- The gas mixture: Ar/C₂H₂

A linear RF electrode of two parallel graphite plates with a confining magnetic field
- Two rotating magnet systems (NdFeB)
- Two, parallel 100 mm graphite plates
- RF: 13.56 MHz
- Bias: 500 W

**Measurements**

Raman spectroscopy: Renishaw inVia Raman microscope, 532 nm laser. Peak fitting – Matlab
Optical emission spectroscopy: PLASCALC - 2000-UV-VIS-NIR
X-ray diffraction: Siemens D5000 diffractometer, GIXRD
Film thickness: Stylus profiler Dektak 150

**Results**

**Raman spectroscopy**

- DLC on Si wafer
  - D: 1377 cm⁻¹
  - G: 1582 cm⁻¹
  - I_D/I_G = 2.6
- DLC on a glass plate
  - D: 1338 cm⁻¹
  - G: 1595 cm⁻¹
  - I_D/I_G = 1.7

- DLC on a glass plate
  - D: 1387 cm⁻¹
  - G: 1562 cm⁻¹
  - I_D/I_G = 1.6
- DLC on a glass plate
  - D: 1372 cm⁻¹
  - G: 1580 cm⁻¹
  - I_D/I_G = 1.9

**Optical emission spectroscopy**

- CH (0,0) 3900 Å system - 3889 Å
- CH (0,0) 4300 Å system - 4314,2 Å
- C₂ Swan

**Conclusions**

DLC coatings were deposited directly on glass, without an interlayer.

Adhesion was substantially improved by using a RF bias.
Even thick coatings (∼20 µm) do not exhibit delamination.
Deposition rates reach very high values, up to 350 nm/min for low gas flows and 800 nm for high flows.

**Acknowledgments**

Financial support from the Swedish Energy Agency is gratefully acknowledged.