# 2.45 GHz Microwave Plasma Source SLAN I-DS


Abb. 1: SLAN I-DS

## Scratch resistant plastic lens coatings of high optical and tribological quality

Modern eyeglasses with plastic lenses are lightweight and unbreakable. Furthermore the lenses can be coloured individually. These features have generated a substantial interest in these glasses. However, the lens surfaces are softer and therefore more scratch sensitive compared to mineral glass.

Among several technological approaches to provide scratch resistant surface coatings of high optical and tribological quality microwave plasma polymerisation of silica-based monomers such as hexamethyldisiloxane (HMDSO) is most promising. Argon and/or oxygen are frequently used as carrier gases. The absolute content of oxygen determines the transition from soft polymer to hard $SiO_x$-thin films ($x \approx 2$).

High efficiency 2.45 GHz microwave plasma sources such as the SLAN provide powerful economic means of depositing superior quality optical films with tailored tribological properties. Other than conventional radiofrequency (e.g. 13.56 / 27.12 MHz) based deposition systems SLAN operates most efficiently in the lower mbar range with plasma and radical densities in excess of $10^{13}$ $cm^{-3}$. This so-called "mbar-technology" eliminates the need for costly high-vacuum pumping systems and yields deposition rates of several *µm/min*. High speed single lens processing is possible. If needed graded coatings with continuously varying degrees of compositionally dependent hardness can be deposited from lens to lens.

A major issue in thin film deposition on thermosensitive materials such as plastic lenses is the maximum deposition temperature prevalent in the system. Because of the combination of resonator and surface wave plasma excitation, in SLAN deposition is efficiently achieved downstream reducing deposition temperature and preventing direct microwave coupling into the lens material. Typical deposition temperatures are therefore kept below 50 $^0$C.

Principle

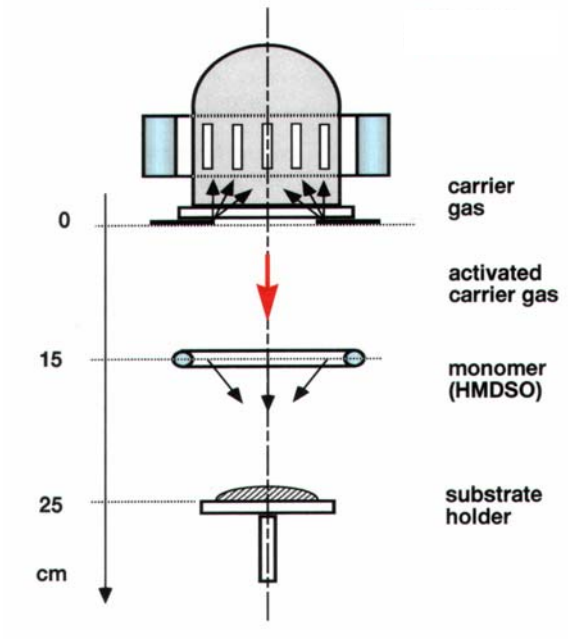


Abb. 2: 2.45 GHz microwave plasma polymerisation of hexamethyldisiloxane (HMDSO) using SLAN I-DS.

The typical process parameter range is:

| | |
|---|---|
| microwave power | 1000 – 2000 W |
| total pressure | 0.7 – 1 mbar |
| flow rate carrier gas | 200 – 350 sccm |
| flow rate monomer | 20 – 200 sccm |
| substrate temperature | 35 – 45 °C |

APPLICATION NOTE

SLAN I-DS

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As tests for the optical and tribological coating quality several test methods have been employed:

**Optical**

| | |
|---|---|
| Thickness: | stylus profilometer |
| Thickness variation: | interference fringes |
| Transparency: | optical absorption |

**Tribological**

Change of light scattering in the visible range after

- rubber abrasion test
  (3000 strokes, constant load)

- tumble abrasion test
  (5 min, quartz and glass particle sizes range from 0.4 to 0.8 mm)

With increasing oxygen content and microwave power the degree of unwanted light scattering is reduced until the scratch resistance of quartz-glass is achieved. At the same time the deposition rate increases to about *0.6 µm / min* (downstream mode).

Typical data for **optimized scratch resistant thin films of high optical quality** in the remote/downstream processing mode are:

Total pressure: 1 mbar

Graded thin films for improved adhesion and reduced stress.

Last step:

| | |
|---|---|
| $O_2$-flow rate: | 400 sccm |
| HMDSO-flow rate: | 50 sccm |
| Microwave power: | 2000 W |
| Deposition rate: | 0,5 µm / min |

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