

# Ion Assisted Deposition (IAD)

## 1. Why IAD?

During reactive evaporation, e.g. for optical applications, energy has to be introduced into the growing film, otherwise it will not adhere well to the substrate, will not be dense and will not be completely oxidized. In case of conventional evaporation processes this energy is introduced by heating the substrate while the film is growing. The necessary temperatures are typically in the range of 250 °C – 300 °C. In case of IAD, the energy is introduced by energetic ions from a suitable ion source and substrate temperatures can be reduced, in many cases to ambient temperatures. The ion source typically produces both ions and electronically excited molecules (radicals). The respective influences of the two species can approximately be described as follows:

### **Energetic ions (mechanical influence):**

- Cleaning of the substrate surface, removing mainly water and hydrocarbons
- Densification of the growing film.
- Removal of loosely bound molecules during film growth.

### **Radicals (chemical influence):**

- Increases reactivity of the reactive gas, better control of film stoichiometry
- Allows for higher deposition (growth) rates.

These advantages are preconditions to achieve films of good quality with reactive coating processes at room temperature. Nevertheless, they also help to broaden the accessible parameter range in case of processes at elevated temperatures.

## 2. Ion source requirements for IAD processes

Ion sources used for IAD processes typically have to fulfill the following requirements:

- Compatibility with reactive gases, particularly Oxygen and Nitrogen
- Sufficient ion current density to make dense moisture stable films.
- Adjustable to allow for control over a wide range of chamber conditions (pumping speed, chamber size). Also, some users will want high currents at low voltages (100ev - 200ev) while others will want higher energies up to 1000 ev and possibly lower currents.
- Reliability, since the ion sources are primarily used in production systems.
- Long cleaning and maintenance cycles with simple ignition and switch-off.

When retrofitting an ion source to an existing coating chamber two additional requirements become important:

- Simple integration of the power supplies into the system controls
- Compact dimensions, since space is sometimes limited in existing coating chambers.