Oxygen Atom Beam Source OBS

OBS 40 on DN40 (O.D. 2.75") CF-flange

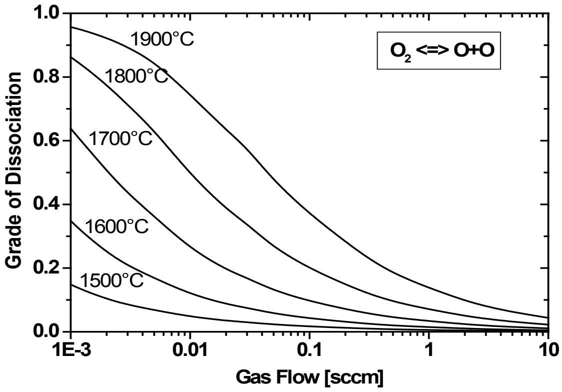
- **O_2 dissociation up to more than 80% depending on operation conditions**
- **Atomic O-flux density up to $1*10^{15}/cm^2*s$**
- **No high-energy particles and ions**
- **Low power consumption**
- **Integrated water cooling, low thermal load on other experimental equipment**

The Oxygen Atom Beam Source OBS is a thermal gas cracker which produces an ion-free oxygen gas beam. The OBS does not cause ion induced damage on the substrate. It exhibits a very compact design and is easy to install and to operate.

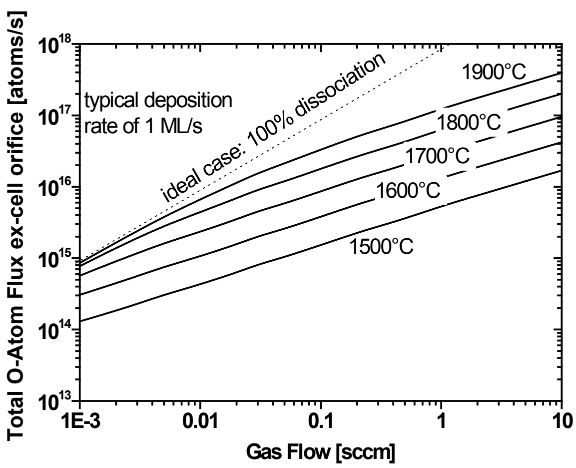
The OBS has been developed in collaboration with Dr. Karl G. Tschersich from the Institute of Thin Films and Interfaces (ISG), Research Centre Jülich (FZJ). It is an extensively tested and well characterized Oxygen source.

The heart of the OBS is a long cracking tube heated by a surrounding filament. Operation temperatures up to 1900°C provide an efficient thermal cracking of O_2 molecules within the tube. The high purity cracking tube is the only part of the OBS with direct contact to the oxygen gas and forms a narrow angle distributed gas beam ejected towards the specimen.
The narrow beam of the OBS provides high atomic oxygen flux rates at the sample position while keeping the O_2 background pressure of the chamber limited as compared to plasma sources. In addition, the high cracking efficiency of up to 80%, which is available for low flux applications, reduces the chamber background pressure significantly as compared to ozone generators, where the ozone concentration is limited to about 10-15%.

Despite the high temperatures used for thermal gas cracking, the thermal load of the chamber is low due to the integrated water cooling and the use of a small diameter aperture.



Grade of dissociation as a function of the gas flow for typical cracking tube temperatures of the OBS. Values are calculated for thermo-dynamical equilibrium condition.



Total flux of O-atoms leaving the cell orifice for different cell operation parameters (gas flow and tube temperature).
A flux of about $1*10^{17}$ atoms/s corresponds to a typical deposition rate of 1 monolayer/s at a typical substrate distance of about 200mm.

Applications

The use of the cracking tube results in a narrow angle distribution of the atomic Oxygen-beam (typical FWHM: 10-30°) which makes the OBS ideally suited for medium and low gas flux applications (up to 0.1 sccm) and smaller sample sizes or long substrate distances.

Due to the highly efficient oxygen cracking mechanism and the resulting low gas load of the vacuum system the OBS is well suited for use in standard UHV, MBE and ALD systems as a reliable, highly efficient and low cost atomic oxygen source.

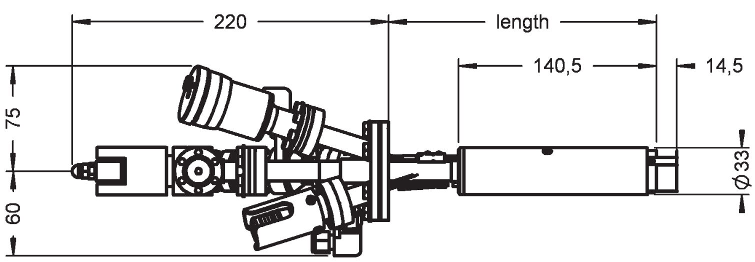
Typical applications for the OBS are:

- Oxide layer deposition
- Surface cleaning procedures (e.g. removal of surface carbon contaminations)
- Surface oxidation (e.g. in ALD technology to form well defined oxide surface layers)
- Atomic spectroscopy of single atoms

Technical Data

Mounting Flange	DN40CF (O.D.2.75“)
Dimensions in Vacuum	190-400mm
Gas injection	Cracking tube
Thermocouple	W5%Re/W26%Re (type C)
Bakeout temperature	300°C
Operating temperature	up to 1900°C
Cooling	integrated water cooling
Options	Aperture (**A**), integrated Shutter (**S**)

Schematic drawing of the
Oxygen Atom Beam Source OBS
(Drawing shows OBS 40 with aperture and shutter)



References:
[1] K.G. Tschersich and V. von Bonin, J. Appl. Phys. 84, 4065 (1998)
[2] K.G. Tschersich, J. Appl. Phys. 87, 2565 (2000)

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