

Extreme ultraviolet (EUV) lithography is considered to be the most favored technique for manufacturing integrated circuits at 65 nm node and beyond. Producing high power of **13.5 nm EUV light** is needed in order to meet the throughput requirement for mass production. In particular, Xenon ions with charge state of ten are found to be responsible for the production of the 13.5 nm line in electromagnetic spectrum. To obtain reasonable concentration of Xe^{10+} ions in the plasma, an **Electron Cyclotron Resonance (ECR)** based plasma generator using **6.4 GHz** microwave frequency has been developed in the Plasma and Ion Source Technology Group at Lawrence Berkeley National Laboratory (LBNL). In this presentation the **status of the Compact ECR Source is shown** and the **EUV light emission measurement system** is presented.

Compact Microwave Plasma Source Design using permanent Magnets

To obtain reasonable intensities of Xe^{10+} ions, C-band (5.9 – 6.4 GHz) microwaves are used. The ECR plasma heating at 6.4 GHz requires ~2200 Gauss magnetic field in the source to couple the microwaves efficiently to the plasma. The magnetic field is produced using permanent magnets. By carefully designing the permanent magnet geometry, an uniform, large volume resonant magnetic field can be obtained. Movable magnet yoke provides a way to fine tune the B-field.

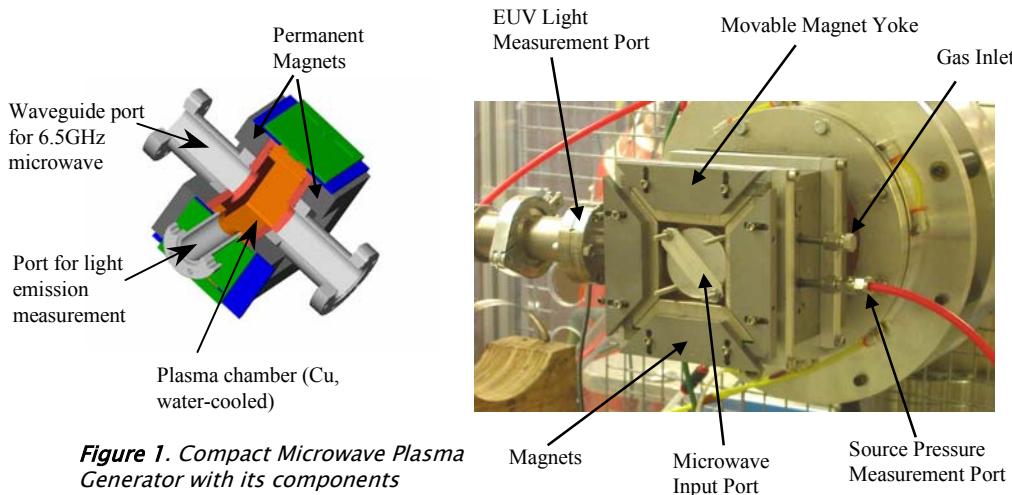


Figure 1. Compact Microwave Plasma Generator with its components

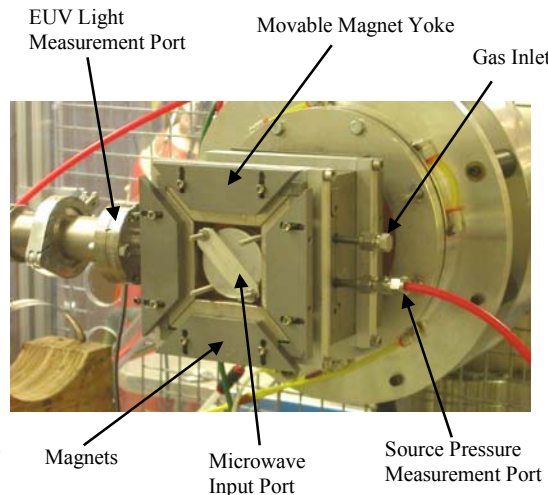


Figure 2. Compact Microwave Plasma Generator in the test stand

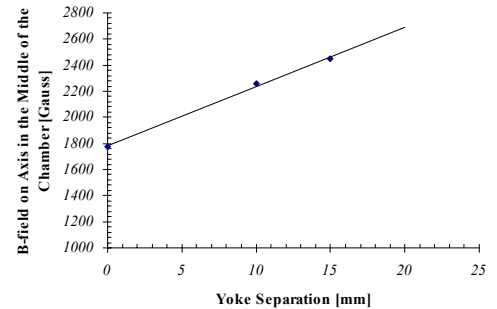


Figure 3. Movable iron yoke pieces provide a means of fine tuning the magnetic field on the axis. This tuning capability can be used in optimizing the production of Xe^{10+} .

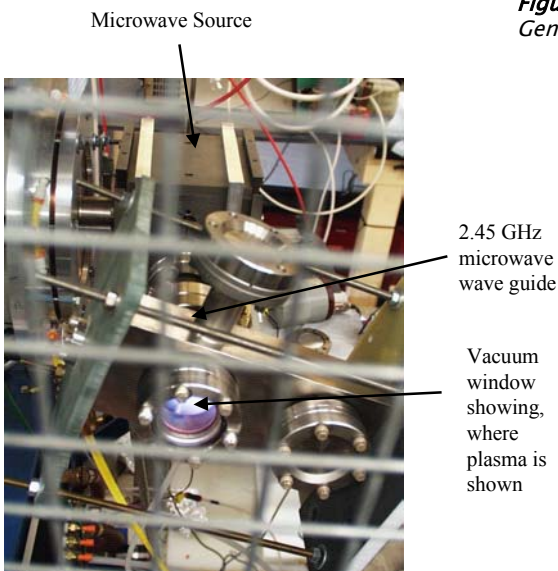


Figure 4. First test runs of the microwave source, using 2.45 GHz microwave transmitter

EUV emission measurement

The EUV emission will be measured by a **grazing incidence monochromator** as shown in Figure 5. The photons pass through an entrance slit 100 mm in width and strike a reflection grating at an angle of incidence of 88°. The 1.5-meter radius concave grating with 600 grooves/mm and a blaze angle of 5° is positioned on a Rowland circle mounting. In this configuration the spectrometer has a **wavelength range of 2-90 nm**. After reflection the photons pass through an exit slit also of 100 mm width where they are then detected by a **channeled electron multiplier (CEM)**, also known as a channeltron. The exit slit is mounted on a stepper motor which can be moved to different wavelength positions. With both slits set at 100 mm, a resolution of approximately 0.1 nm at a wavelength of about 30 nm can be obtained.

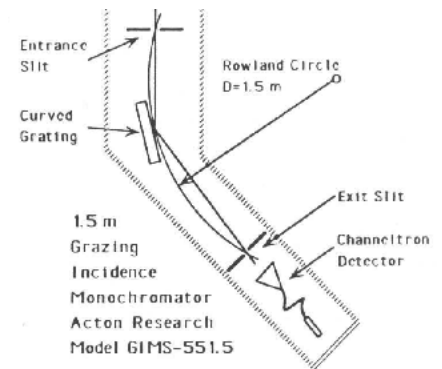


Figure 5. A schematic view of the 1.5m grazing incidence monochromator.