# Quantemol-D/HPEM example 1: Argon inductively-coupled plasma (ICP)

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September 7, 2011

In this example, a relatively simple inductively-coupled plasma based on the single gas Ar is examined. The version of HPEM underlying Quantemol-D is that of March 2011 (“mar11”).

The details of the calculation are shown in Table 1.

| Excitation type | Inductive |
|---|---|
| Pressure | 15 mTorr |
| ICP Power | 300 Watt |
| Electron treatment | Boltzmann |
| Flow rate | 100 sccm |

Table 1: Settings for Ar ICP example.

The grid used to represent the simulation chamber is shown in Figure 1. A set of coils sits at the top of the chamber. The coils are separated from the plasma (black region in the figure) by a quartz window (coloured cyan). Gases flow into the chamber through the nozzle on the right, about 2/3 of the way up the reactor (coloured purple). The wafer (red) sits on a stage (yellow). Gases are removed through the pump port at the bottom right of the diagram (indigo).

We show the convergence of chamber-averaged concentrations of the plasma species in Figure 2. For the first half of the simulations, numerical acceleration is used, which is the reason for the oscillations seen in the left half of the plot. When the acceleration is turned off, the profiles become smoother. The species concentrations converge well.

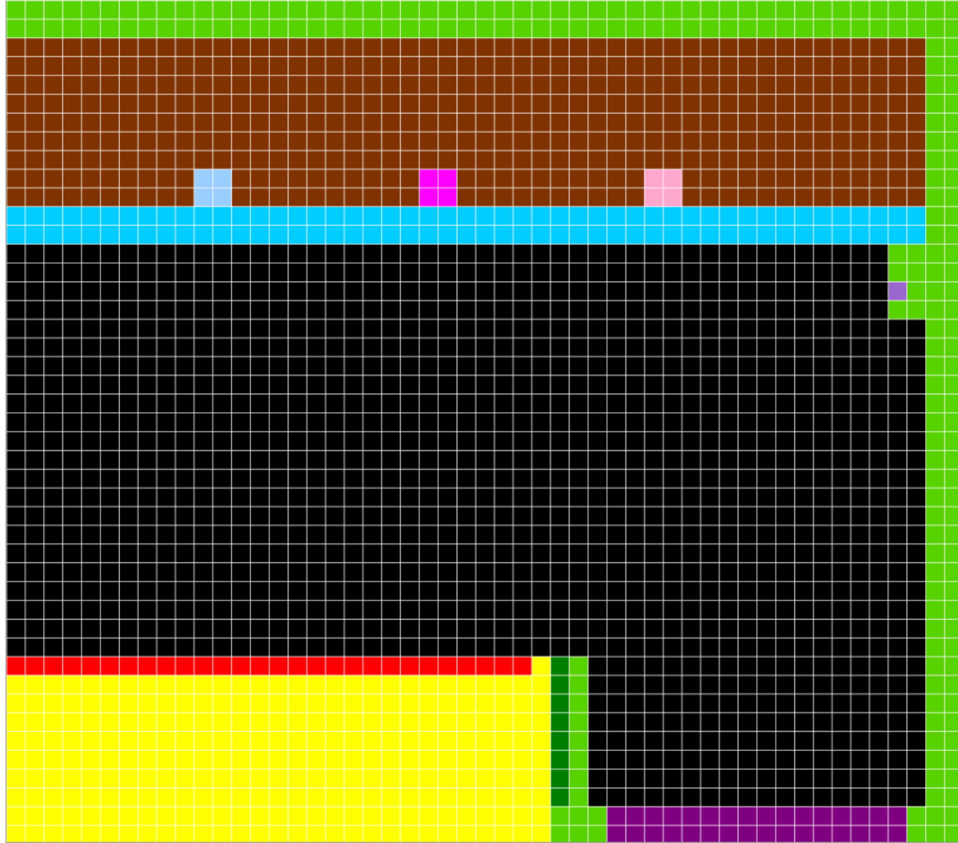

Figure 1: Model for Ar ICP plasma chamber.

The inductive power deposition in the reactor is shown in Figure 3. Clearly the inductive power deposition is concentrated at the top of the chamber, adjacent to the coils. Fluxes across the wafer appear in Figure 4. The flux varies by less than 50% from the centre to the edge of the wafer.

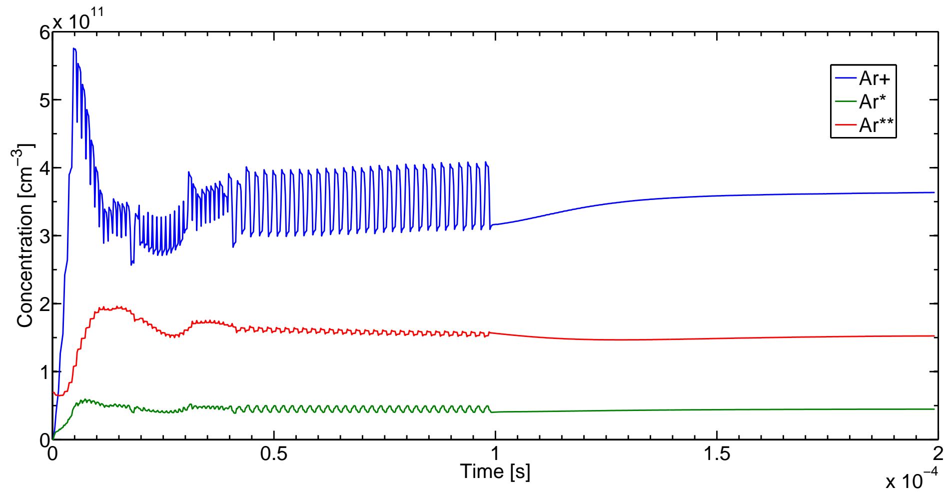


Figure 2: Convergence of plasma species concentrations for Ar ICP example.

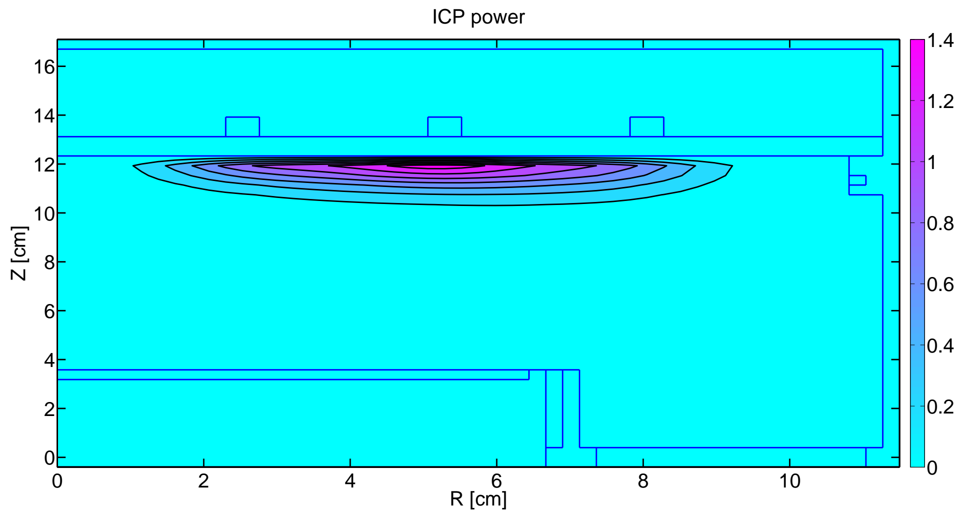


Figure 3: Power deposition in Ar ICP reactor.

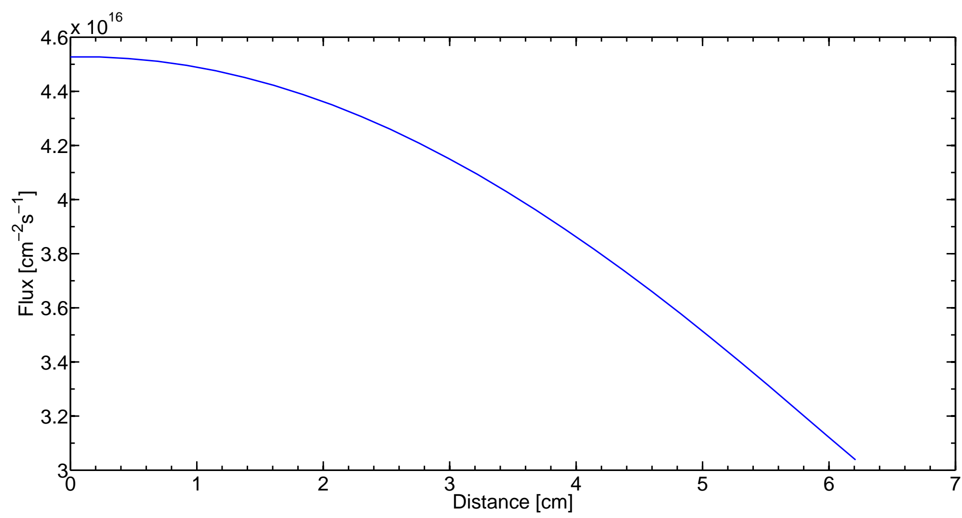


Figure 4: Positive ion fluxes onto wafer for Ar ICP plasma chamber.