Tuning in ICP-MS

As with all analytical instruments, an ICP-MS must be tuned prior to analysing samples. This software simulates the tuning process using input data obtained from a sector-field ICP-MS instrument, the Element XR.

Tuning is often performed by adjusting instrumental parameters and monitoring their effect on the measured signal for multiple elements of interest. Typically this involves the aspiration of a 1 ppb solution of lithium, indium and uranium. The Element XR has a factory specification of at least 1 million counts per second (cps) per ppb of indium, but in practice higher sensitivities than this are often achieved. Whilst high sensitivity is a desirable characteristic, it is not the sole factor used to determine the optimum conditions. Molecular ion interferences formed from the plasma and atmospheric gases can affect the reliability of ICP-MS measurements. Thus the ratio between uranium oxide and uranium is monitored and should be kept below 5%.

In this example many of the settings inside the mass spectrometer have been tuned for you. You will need to adjust the settings that influence sample transport, the ionisation efficiency and transmission of ions into the mass spectrometer (the sample gas, RF power and torch position – see *Figure 1*). The objective is to achieve the highest possible sensitivity for indium, whilst keeping the oxide ratio as low as possible.

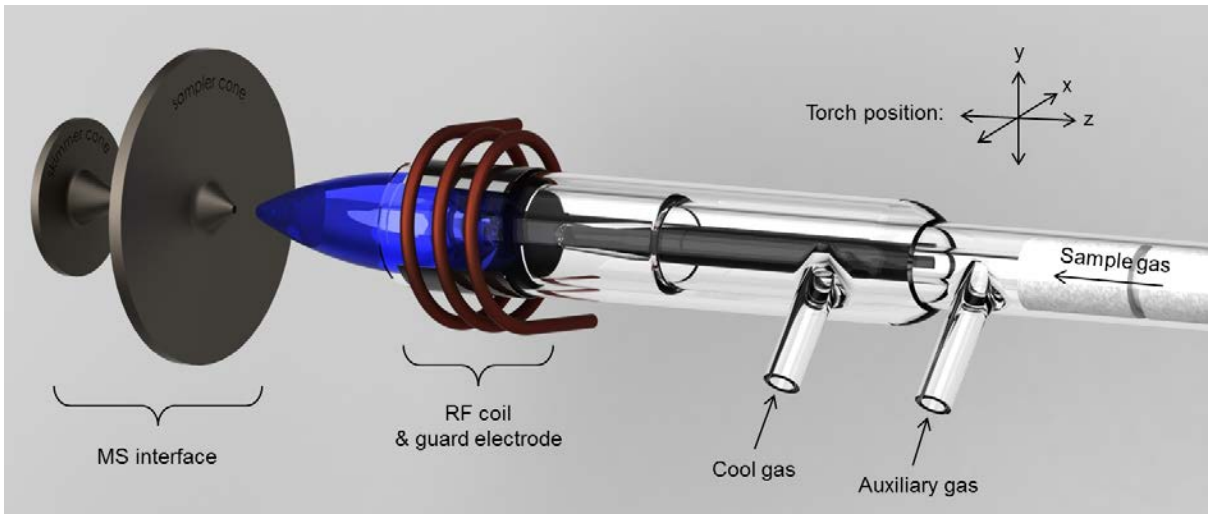

Figure 1. The ICP-MS interface.

Gas flows

The ICP torch consists of three concentric tubes, through which argon flows. The outer two flows, the auxiliary and cool gases, must be finely balanced in order to control the shape of the plasma and to shield the torch from melting. Thus, these two parameters are not

routinely tuned and have already been optimised for you. The sample gas, introduced through the inner tube, drives the nebuliser and controls how much of the sample reaches the plasma. The optimum flow will vary depending on factors such as the type of sample and the nebuliser, spray chamber and connecting tubing used. Flow rates of at least 0.2 L/min are required to achieve 'punch through' of the sample through the middle of the plasma, but in practice the optimum flow is usually between 0.7 and 1 L/min.

RF Power

Radio frequency power is supplied through a water cooled copper coil. The resulting electrical field is responsible for forming and sustaining the inductively coupled plasma. The amount of RF power supplied controls the ionisation efficiency of the plasma and this can be tuned, within set limits. A platinum guard electrode is usually positioned between the torch and RF coil, which reduces the spread of ion energies produced within the ICP and improves the ion transmission efficiency.

Torch position

The inlet of the mass spectrometer consists of two metal cones, each with a narrow orifice to allow ions to pass through into the mass spectrometer (sampler cone orifice ~1.2 mm, skimmer cone orifice ~0.8 mm). The torch position may be adjusted in the *x,y* and *z* directions to allow alignment of the central channel of the plasma with this hole in the cones i.e. this parameter strongly relates to ion transmission to the mass spectrometer.