New High Resolution Radio Frequency Glow Discharge Mass Spectrometry (GDMS) System.

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While the use of radio frequency (rf) powering is now the norm for glow discharge optical emission spectroscopy (GD-OES), the same cannot be said in terms of the market place for GDMS. The advantages realized in rf powering of GD-OES include rapid plasma stabilization, long term stability, high line-to-background ratios and the ability to analyze insulating materials directly. It must be pointed out that these benefits are realized for conductive and non-conductive samples alike, as many metals naturally have insulating coatings. The challenges and potential benefits of rf powering in GDMS are greater than the OES application. Challenges occur because the mass analyzer samples only a limited portion of the plasma, source high vacuum must be achieved to alleviate residual gas suppression and molecular ion effects, GDMS samples tend to take on diverse shapes, and in some cases the ion volume must be floated at high accelerating voltages. The potential benefits of GDMS of course lie in the extremely low detection limits that can be achieved, the ability to assess isotopic composition, and the ability to characterize “molecular” materials such as polymers.

We describe here the preliminary characterization of a new, rf-GDMS system; the MSI Autoconcept GD90-rf. The Autoconcept is a forward geometry, double-focussing mass analyzer which operates at an accelerating potential of 8 kV to achieve a resolving power of 20,000 with variable slit width control in the dc-GDMS mode. A direct insertion probe is employed to deliver either pin- or flat-type samples to the liquid nitrogen or cryogenically-cooled cell volume. Conversion to rf-GD operation has been affected in a straightforward manner following technology initially developed at Clemson University and the Oak Ridge National Laboratory and enhanced at MSI. A continuous rf plasma operating at 13.56 MHz at powers of up to 40 W, using an auto-matching network to efficiently couple the energy across a wide range of plasma and sample situations. Effective operation in the rf mode ensures no degradation of mass analyzer performance or added detector noise. Basic system performance for metals and glass matrices will be presented along with direct comparisons between the rf- and dc-modes for a high purity Ta sample. Tantalum is a challenging matrix as it tends to form oxides on the surface if any oxygen is present. Based on the performance to date, it appears that the benefits realized in optical sampling will be translated to high-resolution rf-GDMS.