RFQ reaction cells for AMS: developments and applications

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The use of Radiofrequency Quadrupole (RFQ) guided ion-gas reaction cells has been shown to be very effective in the elimination of a number of atomic and molecular isobars which have caused difficulties for Accelerator Mass Spectrometry (AMS) measurements [1, 2]. However, the transformation of the equipment used for these proof–of–principle measurements into a system suitable for routine analysis has required attention to many of the aspects of the ion beam transport and gas handling sub-systems. For example, the cross sections of the ion-gas reactions, involving both the analyte ion as well as the isobar, are critically dependent on the ion energy. This has to be reduced from the ion source energy, usually between 20 and 80 keV, to energies typically in the range of several eV, a task which is complicated by the energy spread and the divergence of beams from AMS sputter sources. With simulations using SIMION 8.1 [3] and tests of promising configurations in a laboratory test system, several guiding principles for the design of the retarder optics have been developed. These will be discussed, along with the design currently being implemented and the results of the simulations and tests leading to this design.

Applications of this technique to heavier ions have frequently involved the use of fluoride anions which both extend further the range of elements that AMS can analyze and provide, in the ion source as well as in the reaction cell, significant isobar rejection capability [4]. Applications of the ion-gas reaction cell technique presented will include recent measurements on these molecular super-halogen anions. In particular, tests on molecules incorporating actinides and fission fragments are in progress, one of which has demonstrated the ability to distinguish between ^{238}U and ^{238}Pu.

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