

PT6 New methods of mass spectrometry based on an Electron Cyclotron Resonance Ion Source

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Use of multiply-charged ions is a powerful technique for suppression of molecular backgrounds.

We are investigating the use of multiply-charged atomic ions for measuring isotopic ratios by mass spectrometry. With multiply-charged ions, molecular interferences are reduced or eliminated, as small molecules generally cannot exist as multiply-charged ions. The Electron Cyclotron Resonance Ion Source (ECRIS) provides a highly efficient means to produce multiply-charged atomic ions beams [1]. Applications include measurement of radiocarbon in small mass samples, as an alternative to Accelerator Mass Spectrometry (AMS). In our method for radiocarbon [2, 3], the same two principles that enable AMS to work are used, but in reverse order. Molecular interferences are eliminated by producing high charge state ions directly from an ECRIS. ^{14}N interference is eliminated in the second stage, by converting the beam to negative ions in a charge exchange cell.

In another application of the ECRIS, we are using it with a single magnetic sector analyser to determine stable isotopic ratios such as $^{13}\text{C}/^{12}\text{C}$ and $^{18}\text{O}/^{16}\text{O}$. Measurements of these and other stable isotopes are widely used in geo- and bio-sciences, where either natural variations are studied or isotopic tracers are used. Conventional isotope ratio mass spectrometers use molecular ions (such as CO_2^+) to determine such ratios. In our method [4], $2+$ atomic ions are selected, thereby eliminating possible molecular interferences and resolving mass ambiguities that exist with the conventional molecular ion method.

[1] R. Geller, *Electron Cyclotron Resonance Ion Sources and ECR Plasmas*, IOP, Bristol, 1996.

[2] R. Middleton, in *Proc. First Conf. on Radiocarbon Dating with Accelerators*, H.E. Gove (ed.), Rochester, USA, 1978.

[3] M.A.C. Hotchkis and T. Wei, *Nucl. Instr. & Meth. B* 2007, 259: 158-164.

[4] M.A.C. Hotchkis, D. Button and C.L. Waring, *Rapid Comm. Mass Spectrom.* 2008, 22: 1408-1414.