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ISOTOPIC EFFECTS ON THE ELECTRON-IMPACT DISSOCIATION OF HDO^+

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Absolute cross section measurements are reported for electron-impact dissociative excitation and ionization of HDO^+ to the heavy diatomic fragments, OD^+ and OH^+. The electron energy range extends continuously from the threshold of the initial reaction (excitation or ionization) up to 2.5 keV. The ion beam is produced in an ECR ion source, filled with a mixture of H_2O, HDO and D_2O vapors, and accelerated to 3–4 keV. After magnetic selection, the primary HDO^+ ion beam crosses the electron beam. A 90° magnetic analyzer separates product ions (either OD^+ or OH^+) from the primary beam. Magnetic field scans allow the determination of the kinetic energy release (KER) distribution of fragments for a given incident electron energy [1]. Around the maximum, absolute total cross sections are measured to be $(7.9\pm0.3)\times10^{-17}$ cm^2 and $(2.5\pm0.1)\times10^{-17}$ cm^2 for OD^+ (σ_{OD}) and OH^+ (σ_{OH}), respectively, showing an isotopic effect favoring the OD^+ channel over the OH^+ channel. The contribution of dissociative ionization to the cross sections and to the KER are isolated and their analysis shows that the isotopic ratio, which is defined as the ratio of σ_{OD} to σ_{OH}, is observed to be almost constant in the 30–2500 eV energy range, with a value of (3.1 ± 0.2) on average.

These results are compared to theoretical data which are obtained by (i) calculating the ionization cross sections [2] and (ii) by simulating the dissociation dynamics of HDO^{++} on 3-body potential energy surfaces that produce either OD^+ or OH^+ [3]. Simulations are performed for different temperatures. A comparison with the experimental isotopic ratio indicates that the ECR ion source produces an ion beam around 4000K.

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