Determination of the SmO^+ bond dissociation energy using cryogenic ion spectroscopy

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One of the current missions of the air force is to produce an artificial region of high electron density in the upper atmosphere with the ability to propagate high frequency radio waves consistently and reliably over the horizon. The current method being tested is the release of vaporized samarium to react with oxygen in a chemi-ionization process that ionizes the samarium oxide and releases an electron. In order to maintain this electron cloud the chemi-ionization process has to be exothermic to avoid dissociative recombination reducing electron density. Here we present the measurement of the SmO^+ bond energy by monitoring the threshold for photodissociation of the cryogenically-cooled ion. The action spectrum features a very sharp onset indicating a bond energy of 5.598 ± .006 eV. This, combined with the literature value of the samarium ionization energy, indicates that the chemi-ionization process is endothermic by .046 ± .006 eV, which may have important implications on the efficacy of Sm atoms for the MOSC missions. We also obtained the vibrational spectrum of the SmO+ ion “tagged” with He atoms to ensure that there is only one electronic state involved in the UV photodissociation measurements.