INTERSTELLAR PEPTIDE BOND FORMATION BY ACETALDEHYDE AND AMMONIA IN ANALOG ICE

JOSHUA H MARKS, JIA WANG, *Department of Chemistry, University of Hawaii at Manoa, Honolulu, HI, USA*; ANDRÉ K. ECKHARDT, *Department of Chemistry, Massachusetts Institute of Technology, Cambridge, MA, USA*; N. FABIAN KLEIMEIER, ANDREW MARTIN TURNER, RALF INGO KAISER, *Department of Chemistry, University of Hawaii at Manoa, Honolulu, HI, USA*.

Observation of complex organic molecules containing peptide bonds such as acetamide and propionamide in the interstellar medium raises the prospect of amino acid formation. Reactions of interstellar ice analogs containing acetaldehyde and ammonia were investigated to better understand the reactivity of oxygen-containing organic molecules with ammonia. These ices were submitted to energetic electron irradiation to simulate the effects of secondary electrons generated by galactic cosmic rays. Photoionization mass spectrometry was used to detect reaction products, while four-wave mixing provided tunable vacuum UV light for single photon ionization. Isotopically labeled acetaldehyde was employed to verify the formula of the observed reaction products. Electronic structure calculations at the CCSD(T)/CBS level predicted the adiabatic ionization energy of all plausible isomers. The differences between the ionization energies of the C_2H_5NO reaction products were used to identify the isomers present. The amino radical, NH_2, was found to bind to the acetaldehyde radical at either carbon. This resulted in the formation of 1-aminoacetaldehyde ($CH_3C(O)NH_2$), better known as acetamide, and 2-aminoacetaldehyde (NH_2CH_2CHO). Furthermore, with sufficient irradiation, high energy tautomers of both 1- and 2-aminoacetaldehyde were found to form. Both 1-aminoethenol ($CH_2C(OH)NH_2$) and 2-aminoethenol ($OHCHCHNH_2$) were identified by measurement of their photoionization efficiency spectra.