UV Photolysis of Amino Acids in Solid Parahydrogen and its Relevance to Astrochemistry

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One of the hot topics in the field of astrochemistry is the study of amino acids and their role in prebiotic chemistry. Although more that 10 amino acids have been identified in meteorites and comets, no gas phase amino acids have been detected in interstellar molecular clouds. The photo-stability and photochemistry of amino acids is of particular importance in interstellar chemistry, due to the abundance of high energy radiation, including ultraviolet (UV). Our group has been studying amino acids isolated in solid parahydrogen. Because parahydrogen provides cage-free environment to guest molecules, it is especially useful for the in-situ photolysis study. We have studied UV photolysis of several amino acids isolated in solid parahydrogen and found that the primary dissociation via UV photons near 200 nm always occurs at the C-C bond for the carboxyl group, resulting in the product of the HOCO radical. The counter amine radicals generated by the α-carbonyl C-C bond cleavage rapidly undergo hydrogen elimination to yield an imine. The importance of these findings relevant to astrochemistry is that the UV photodissociation of amino acids by near 200 nm UV photons produces achiral molecules from the chiral amino acids. Among various proposals for the origin of homochirality, asymmetric photolysis of amino acids in interstellar space is one of the key mechanisms for the initial imbalance that astrochemists are trying to prove. However, there has not been direct report on asymmetric photodissocialtion of amino acids in its neutral form. The present study suggests that the chiral imbalance can occur via UV photolysis near 200 nm. Details of experiments will be discussed.