Photochemical synthesis of Ammonia and Glycine

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Abiotic synthesis of ammonia and amino acids are crucial for the origin of life and its early evolution. There are plenty previous studies about abiotic synthesis of ammonia or ammonium by reduction of $NO/NO_2^-/NO_3^-$ in the presence of Fe^{2+} [1][2] or FeS[3][4][5], and previous studies also showed that glycine could be synthesized abiotically by reductive amination with FeS under alkaline condition [6][7]. However, none of them focus on reduction reactions through photochemistry without metal. In this study, UV experiments starting from aqueous solution of NO_3^- with H_2 or CO gas were conducted in order to testify whether NH_3 can be produced by reduction of NO_3^- without Fe^{2+}/FeS through photochemical reactions. On the other hand, we also conducted various experiments including reductive amination starting from glyoxylic acid with NH_4Cl under different pH condition in order to confirm the suitable conditions of glycine synthesis under photochemistry. Besides reductive amination, we confirmed that glycine can be produced from aqueous solution of methylamines CH_3NH_2 with CO_2 gas by photochemistry as well. We will discuss these new UV experiments and its implication for the origin of life.

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