UV photochemistry and thermal processing of ketene under interstellar conditions: from rare gas matrix isolation to interstellar ice analogs

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Interstellar ketene was detected in space almost fifty years ago, back in 1977, in the dense molecular cloud Sagittarius B2. Such a simple organic species of astrophysical interest plays an important role in prebiotic astrochemistry and has been a subject of several experimental and theoretical investigations. By combining laboratory astrochemical studies in bulk amorphous ice phase and in rare-gas matrices (Ar, Ne), this work aims to understand the UV photochemistry of CH_2CO in the solid phase under interstellar conditions. The thermal processing and the UV light treatment of CH_2CO in the diluted and the concentrated phases have been monitored by means of Fourier transform infrared (FTIR) spectroscopy and mass spectrometry. Different behaviours are observed for the photolysis of ketene depending on the environment where CH_2CO is trapped. We show that while the irradiation of CH_2CO/Ne or CH_2CO/Ar samples in the 3 - 10 K temperature range leads to stable molecules (CH_4, H_2CO, C_2H_2 and CH_3CHO) and reactive radical species such as C_2O, HCCO and C_3O which are stabilized in neutral rare-gas crystals, the UV processing of CH_2CO ice analogs leads mainly to an organic residue which remains in solid phase even at room temperature. Different reaction mechanisms will be discussed to describe the evolution of the photoproducts formed during the photolysis of CH_2CO, from the bulk phase to the solid-gas interface.

Keywords : astrochemistry - molecular processes - methods: laboratory: solid state - techniques: spectroscopic - ISM: molecules