Simulation of cold astrochemical processes through matrix isolation: an insight from solid state radiation chemistry

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The laboratory simulation of the radiation-induced ice astrochemistry can strongly benefit from model matrix isolation studies.[1] Generally, it is well known that matrix isolation can be used for obtaining detailed spectroscopic characteristics of astrophysically relevant molecules and intermediates due to stabilization of unstable species and superior spectroscopic resolution. Meanwhile, this report is focusing on a brief overview of new opportunities of this technique for unraveling major mechanistic issues of the ice astrochemistry as revealed by recent studies in our laboratory.[2-8] The principal point is that, both in matrices and in molecular ices, one should consider the impact of radiation chemistry, when the energy is primarily absorbed by the medium and energy transport to a guest species (positive hole and excitation transfer) is crucial. First, the physical characteristics of inert matrices (from Ne to Xe) may vary in a wide range, which strongly affects the efficiency of hole and excitation transfer and the fate of ionized species.[2-5] In principle, this concept can be also applied to simple astrophysically relevant molecular media. Second, the matrix isolation technique is uniquely suitable for investigation of the radiation-induced evolution of isolated intermolecular complexes, which may be considered as principal "building blocks" in cold synthetic astrochemistry providing direct access to the early stages of the corresponding processes.[6-8] Finally, due to very high efficiency of the energy transfer to target species in matrices, this approach opens up new insight into "accelerated history" of the system, because the step-by-step evolution (taking huge time in reality) may be followed at moderate absorbed doses. The unresolved issues will be also addressed and the prospects for different-type astrochemical studies will be outlined.

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