Exploiting Molecular Beams and Surface Science Studies to Untangle the Formation of Complex Organics in Deep Space - From Nanoparticles to Interstellar Ices

Ralf I. Kaiser[1,2]

[1]*Department of Chemistry, University of Hawaii at Manoa, Honolulu, HI 96822, USA*

2 W.M. keck Research Laboratory in Astrochemistry, University of Hawaii at Manoa, Honolulu, HI 96822, USA

Ice coated interstellar nanoparticles have emerged as molecular factories in the synthesis of (aromatic) hydrocarbons and of complex, biorelevant organics in cold molecular clouds and in star forming regions. An detailed understanding of the fundamental reaction mechanisms leading to these organics in deep space requires new knowledge not only on the formation of these nanoparticles (carbonaceous, silicates, sulfides) from the bottom up via elementary gas phase reactions, but also on the processing of low temperature ices by (non)ionizing radiation present even deep inside cold molecular clods. Extensive gas phase and condensed phase (ices) physical chemistry laboratory experiments have been at the center of attention in providing this knowledge. This talk provides an overview on recent molecular beams experiments (gas phase) and surface science studies (ice chemistry) of particular importance in deciphering the underlying reaction dynamics and kinetics leading to fundamental molecular building blocks of interstellar nanoparticles and to complex organics of astrobiological significance and concludes with new developments in this field. The gas-phase studies have culminated in the preparation of planar (2D) and bent (3D) polycyclic aromatic hydrocarbons (corannulene [1], coronene [2], C40 nanobowls [3], helicenes [4-6]) involving multifaceted reaction mechanisms [7] as fundamental molecular building blocks of graphenes, fullerenes, and nanotubes; surface science experiments advanced to an understanding of the non-equilibrium chemistry leading to C1-C6 complex organics (alcohols, aldehydes/ketones, carboxylic acids, sugars) connected to the *Origin of Life* theme [8-15]

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