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Keynote: Interstellar Catalysis –a Route to Molecular Complexity in Space

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Interstellar space harbours a surprising chemical complexity in spite of the extremely low temperatures and pressures that characterize it. More than 225 different molecules have been detected including both simple molecules such as H2 and water, as well as larger molecules such as C60 and polycyclic aromatic hydrocarbons (PAHs). Even biologically relevant molecules such as glycolaldehyde –a sugar precursor –have been detected. The largest molecular complexity is observed in dense interstellar dust and molecular clouds –the regions where new stars and planetary systems form. Interstellar molecules play a key role in the star and planet formation process and are at later stages delivered to planetary surfaces where they may have contributed to the origin of life. The surprising chemical complexity found in space is thought to be catalyzed by interstellar nanoscale dust grains and large carbonaceous molecules such as polycyclic aromatic hydrocarbons (PAHs). Surface science techniques like scanning tunneling microscopy (STM), temperature programmed desorption (TPD) and density functional theory (DFT) allow us to study and model such reactions on surfaces under conditions that mimic those found in interstellar space. The ultimate aim is to determine the degree of chemical complexity attainable via catalytic reactions at 10 K and under ultrahigh vacuum conditions. Specifically, we aim to discover whether the molecular building blocks of life –amino acids, dna bases, sugars and fatty acids –can form even before the formation of stars and planets, at the extremely low temperatures and pressures found in interstellar space.

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