Ammonium affects the wet chemical network of HCN: Feedback between prebiotic chemistry and materials science.

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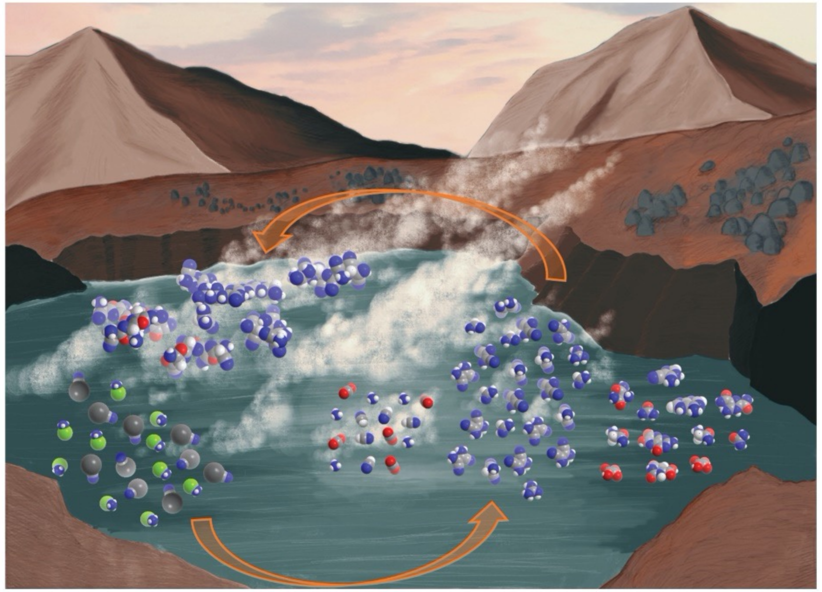

Showcasing research from Prebiotic Chemistry Group of Astrobiology Center (CAB) and the Subdirectorate General for Aeronautic Systems at National Institute of Aerospace Technology (INTA), Torrejón de Ardoz, Spain

Ammonium affects the wet chemical network of HCN: feedback between prebiotic chemistry and materials science

This work explores the effect of the pH and ammonium cation, in the form of the NH_4Cl salt, on the kinetic and properties of the cyanide-based polymers. These highly complex polymerizations are pH and ammonium subservient, showing that this cation concentration can modulate the magnetic, optical, morphological, crystallographic and thermal properties of the cyanide polymers.

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See Marta Ruiz-Bermejo *et al.*, *Phys. Chem. Chem. Phys.*, 2023, **25**, 20473.

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Prebiotic chemistry one-pot reactions, such as HCN-derived polymerizations, have been used as stimulating starting points for the generation of new multifunctional materials due to the simplicity of the processes, use of water as solvent, and moderate thermal conditions. Slight experimental variations in this special kind of polymerization tune the final properties of the products. Thus, herein, the influence of NH4Cl on the polymerization kinetics of cyanide under hydrothermal conditions and on the macrostructures and properties of this complex system is explored. The kinetics of the process is consistent with an autocatalytic model, but important variations in the polymerization reaction are observed according to a simple empirical model based on a Hill equation. The differences in the kinetic behaviour against NH4Cl were also revealed when the structural, morphological, thermal, electronic and magnetic properties of the synthesized cyanide polymers were compared, and these properties were evaluated by elemental analysis, FTIR, XPS, UV-vis, and ESR spectroscopies, X-ray diffraction, SEM and thermoanalytical techniques. As a result, this hydrothermal prebiotic polymerization is not only pH dependent, as previously thought, but also ammonium subservient. From this result, a hypothetical reaction mechanism was proposed, which involves the active participation of ammonium cations via formamidine and serves as a remarkable point against previous reports. The results discussed here expand the knowledge on HCN wet chemistry, offer an extended view of the relevant parameters during the simulation of hydrothermal scenarios and describe the production of promising paramagnetic and semiconducting materials inspired by prebiotic chemistry.

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