Deep Eutectic Solvents: Properties Induced by Nanometric Confinement

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Over the past decade, Deep Eutectic Solvents (DESs) have garnered significant attention within the scientific community due to their remarkable functional properties, positioning them as promising alternatives to conventional solvents in green chemistry initiatives [1,2]. Notably, DESs exhibit unconventional behavior stemming from the formation of nanoscopic domains and dynamic heterogeneity across nanometers scale, attributed to the intricate interplay of ionic and hydrogen bonding interactions among their molecular constituents [3,4]. Consequently, unravelling the physicochemical intricacies of DESs at the mesoscopic level has emerged as a pivotal pursuit. The interrogation of DES behavior under mesoporous confinement stands as a particularly pertinent endeavour, given the pivotal role of interfaces and nanopores in numerous targeted applications of these solvents. Hence, a pressing question arises regarding the impact of mesoporous confinement on the structure and dynamic (diffusion, rotation and relaxation) heterogeneities inherent within DES systems [5,6].

The structural and dynamic behavior of Ethaline—a deep eutectic solvent (DES) consisting of choline chloride and ethylene glycol—was analyzed in both bulk and confined states within mesostructured porous silicas (SBA-15) using Neutron Diffraction and Incoherent Quasielastic Neutron Scattering (QENS) experiments. A broad dynamical range was achieved by combining of time-of-flight (IN5B) and backscattering (IN16B) QENS spectrometers, yielding complementary energy resolution capabilities. This study offers a detailed microscopic characterization of the confined Ethaline system, evaluating parameters including the elastic incoherent structure factor, diffusion coefficients, residence times, relaxation times, and their temperature-dependent behavior [7-9].

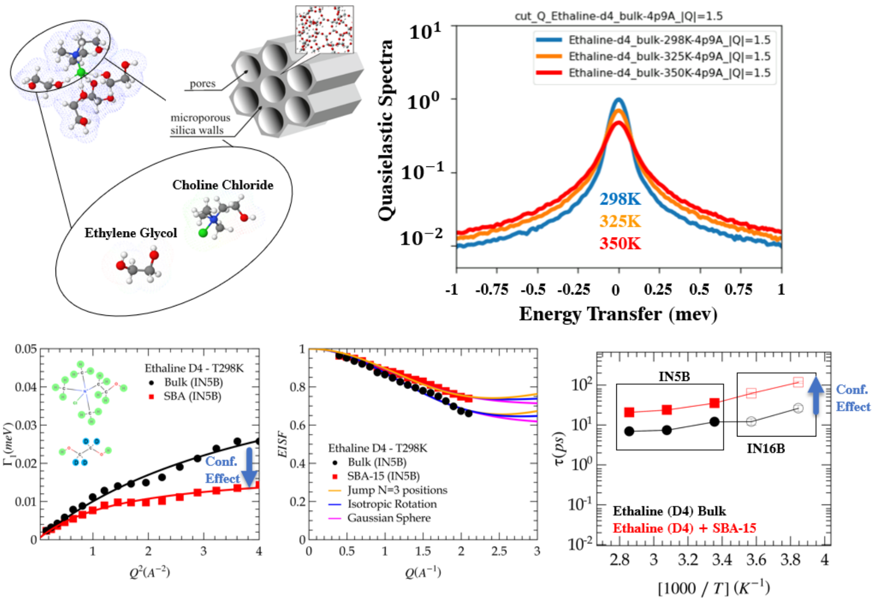

Figure: (upper panel) Sketch of studied systems and their dynamic structure factor. (lower panel) Confinement effect on the Quasielastic broadening of the slow (jump-diffusion) process, elastic incoherent structure factor (EISF), and temperature dependance of the residence time.

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