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Dynamics and conductivity of nanoconfined amino acid based ionic liquid crystals: Influence of the side chain length

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Ionic Liquid Crystals (ILCs) are emerging class of materials that combine the properties of liquid crystals with ionic conduction similar to ionic liquids. It's known that liquid crystals exhibit intriguing properties when confined, and are of importance from both fundamental and technological perspectives. Here, we study the molecular dynamics and electrical conductivity of a homologous series of Dopamine (DOPA) based ILCs, ILCn (n = 12,14,16) confined in self-ordered nanoporous alumina oxide membrane of 180 nm pore size using Broadband Dielectric Spectroscopy (BDS). We aim to understand how the alkyl chain length and confinement influence the dynamics in this system.
In bulk, for all ILCs, we observe two relaxation modes in the crystalline phase, the and α1 relaxation respectively, and one relaxation mode in the columnar phase, the α2 relaxation, but for ILC16, where two relaxation modes (α2 and α3) are detected in the columnar phase.
For the confined case, all relaxation processes slowdown compared to the bulk. For ILC16, the α1 relaxation is completely suppressed. For all ILCs, the absolute values of DC conductivity are reduced by three orders of magnitude. We discuss in detail the possible molecular origin of the relaxation processes and the charge transport in this system.

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