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Characterization of critical micelle concentration of ionic liquid on molecular length scale by X-ray surface scattering and spectroscopy study[1]

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Ionic liquids (ILs) with long alkyl chains tend to form micelles in aqueous solutions once the critical micelle concentration (CMC) is reached, a phenomenon commonly described by the Gibbs isotherm for ionic surfactants. We report synchrotron X-ray measurements at far below, near and above the CMC of each IL of 1-dodecyl-3-methylimidazolium halides, $[C_{12}mim]X$, (X=Cl,Br,I). Our X-ray reflectivity measurements provide the depth density profiles of the interfacial films formed by the ILs. A liquid state of the alkyl chains can also be identified by grazing incidence X-ray diffraction measurements that reveal the in-plane packing of the IL molecules. The ILs form monolayers on the aqueous surfaces and the cations $[C_{12}mim]^+$ bind with Cl^- and I^- ions with different affinity. We discuss our experimental results of surfactants surface enrichment in the context of Gibbs equations.

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