**Adventures at liquid surfaces and interfaces**

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Liquid surfaces and interface abound in living matter, industrial processes, and everyday life and activities. Elucidating their structure is prerequisite to the understanding of the functionalities involved and thus highly important. This talk will address briefly some of the liquid surfaces and interfaces studied to date by x-ray methods, e.g. “simple” liquids like water [1] and liquid metals [2], and the more intricate chain molecules [3]. The main focus will be, however, on Room Temperature Ionic Liquids (RTILs) [4,5], a novel class of Complex Liquids, the study of which has grown explosively since the mid-1990’s, due to their many applications, ranging from electrochemical devices, through lubrication and pharmaceutical synthesis, to environmental application like CO2 capture and industrial sludge treatment, and even to targeted drug delivery within the human body. Their tunable balance of competing dominant Coulomb and Van der Waals interactions, along with a number of more-minor other interactions, renders RTILS most interesting scientifically as well. We will discuss our recent x-ray studies of the surface and bulk structure of a model homologous series of RTILs, [CnMIM][NTf2], (n denoting the number of carbons in the cationic alkyl chain), which reveal the surface-bulk structural relations, and demonstrate intriguing structural variations with n, temperature, and the nature of the interface.

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[2] O.M. Magnussen et al. *PRL* **74**, 4444(1995); O. Shpyrko et al. *PRB* **69**, 245423(2004); S. Mechler et al. *PRL* **105**,186101(2010).

[3] X.Z. Wu et al. *Science* **261**, 1018 (1993); B.M. Ocko et al. *PRE* **55**,3164 (1997); S. Guttman et al. *PNAS* **113**, 493(2016); S. Das et al. *Nat. Phys*. **18**, 1177(2022)

[4] E. Sloutskin et al., *JACS* **127**, 7796(2005); M. Mezger et al. *Science* **322**, 428(2008); *PNAS* **110**, 3733(2013).

[5] J. Haddad et al. *PNAS* **115,** E1100(2018): D. Pontoni et al. *SM* **13**, 6947(2017); *JPCC* **123,** 3058(2019); *JML* **355**, 118874 (2022); *JCIS* **661**, 3(2024).