Max-Planck-Institut für Struktur und Dynamik der Materie

Max Planck Institute for the Structure and Dynamics of Matter

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CFEL Seminar room III (Bldg. 99)

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Aqueous Nanoscale Systems

Water is the most important liquid for life. It is intimately linked to our well-being. Without water, cell membranes cannot function. Charges and charged groups cannot be dissolved, self-assembly cannot occur, and proteins cannot fold. Apart from the intimate link with life, water also shapes the earth and our climate. Our landscape is formed by slow eroding/dissolving processes of rocks in river and sea water; aerosols and rain drops provide a means of transport of water. Because of the complexity of liquid water and aqueous interfaces, the relationship between the unique properties of water and its molecular structure has not been solved.

Techniques that can provide femtosecond structural information over multiple length scales can help. For this purpose, we developed nonlinear light scattering [1] and imaging tools [2] to access molecular structural information of aqueous solutions and interfaces. With these methods we have found nanoscale ordering in dilute salt solutions [3], and probed the structure of aqueous nanoscale interfaces relevant for chemistry and biology: emulsions [4], lipid droplets [5], liposomes [6] and water droplets [7]. The optical properties of water can also be used to determine the electrical potential (voltage) of interfaces. This unique spatiotemporally resolved hydration readout is useful for chemistry [2], biophysics [8], neurology [9] and device characterization. In this presentation I will give an overview of this broad field and our findings.

References

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[2] - Optical Imaging of Surface Chemistry and Dynamics in Confinement, C. Macias-Romero, I. Nahalka, H. I. Okur, S. Roke, Science (2017) 357, 784-788

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[4] - What determines nanodroplet stability?, E. Zdrali, H. I. Okur, Y. Chen, S. Roke, ACS Nano, 111, 12111-12120

[5] - Three dimensional nano 'Langmuir trough' for lipid studies, Y. Chen, K. C. Jena, C. Lütgebaucks, H. I. Okur, S. Roke, Nano Lett. (2015), 15, 5558.

[6] - Intramolecular head group interaction and hydration as driving forces for membrane asymmetry, N. Smolentsev, C. Lütgebaucks, H. I. Okur, S. Roke, J. Am. Chem. Soc. (2016), 138, 4053.

[7] - The interfacial structure of water droplets in a hydrophobic liquid, N. Smolentsev, W. J. Smit, H. J. Bakker and S. Roke, Nat. Commun., (2017), 8, 15548-1.

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[9] – Membrane water as a probe for neuronal membrane potentials and ionic flux at the single cell level, M. Didier, O. Tarun, P. Jourdain, P. Magistretti, S. Roke, Nat. Commun. (2018), 9, 5287.

Host: Andrea Cavalleri

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