Probing the dynamics of single molecules at solid-liquid interfaces: an experimental perspective

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The motion of liquid molecules and solutes at the interface with solids underpins countless processes from heterogenous catalysis to crystal growth, self-assembly and the function of biomembranes. Experimentally, probing the dynamics of single molecules at interfaces remains challenging due to highly localised interactions between the molecules and the surface of the solid. Typical approaches based on spatial and temporal averaging often fail to capture key local information. Atomic force microscopy (AFM) can in principle overcome this issue, especially when complemented by computational approaches. AFM has been used successfully to probe the detailed molecular arrangements of numerous solid-liquid interfaces at equilibrium. Measurements of the dynamics of single molecules at interfaces are however still sparse due to limited time resolution. Recent work [1] has shown that the unusual properties of the interfacial liquid can considerably slow down interfacial dynamics [2] potentially enabling AFM investigation in suitable systems. In this presentation I will review some of our recent results in the field, in particular the implications of interfacial molecules' dynamics for the function of biomembranes [3] and in lubrication processes [4].

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