Self-assembled monolayers (SAMs) of organic molecules form spontaneously from solution on metal surfaces. The self-organization of molecules goes along with an alignment of their molecular dipole moments and results in a shift of the surface potential of the underlying metal. Kelvin Probe Force Microscopy (KPFM) is a powerful tool to investigate local surface potential changes with high spatial resolution [1,2]. In this work, we used KPFM in-situ, in liquids to study the surface potential of µm-sized crosses made from Pt [3]. One of the main advantages of operating KPFM in liquids is that the tip-sample-force can be reduced significantly. Thus, sensitive molecules and soft interfaces are accessible for KPFM. Furthermore, surface contamination by unspecific adsorbates is excluded.

Figure 1: KPFM of a Pt cross deposited on a Si wafer in decane (a) before and (b) after exposure to mercaptohexadecane. (c) Histogram analysis of the surface potential of the Pt and Si surfaces.

Here we will discuss the KPFM measurement mode in liquids and present an example for an in-situ study of the self-assembly process of mercaptohexadecane in decane. First, we measured the surface potential of the Pt cross in pure decane (Figure 1a). After 70 min of incubation of a solution of mercaptaalkanes in decane the surface potential of the same Pt cross was measured again (Figure 1b). A clear shift in surface potential was observed relative to the Si surroundings. A more detailed analysis of the measured surface potentials revealed that the surface potential of the Pt cross shifted by -185 mV after mercaptohexadecane adsorbed to the Pt surface (Figure 1c). The lowering of the work function is induced by the interfacial dipole layer which is directed towards the metal surface, i.e. the negative charges are positioned at the metal/sulphur interface and the positive charges at the air interface. A comparative study in air showed that the surface potential of Pt and mercaptohexadecane adsorbed on Pt is strongly influenced by additional unspecific adsorbates (e.g. water) on the surface. In conclusion, operation of KPFM in liquids is a major step forward to investigate the surface potential of surfaces, e.g. induced by a chemical reaction.

References: