

Kelvin Probe Force Microscopy in Liquids

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Kelvin Probe Force Microscopy (KPFM) is a powerful tool to investigate local surface potential changes with high spatial resolution [1]. In this work, we used amplitude modulated KPFM in liquids as destruction-free method in non-contact mode. One of the main advantages of operating KPFM in liquids is that the tip-sample force can be further reduced due to the elimination of capillary forces. Thus, soft interfaces are accessible for KPFM and surface contamination by unspecific adsorbates is excluded. 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 hexadecanethiols in decane [2]. We will discuss our findings in comparison to ultra-violet photoelectron spectroscopy (UPS) measurements from literature.

Thin organic films on metal surfaces lead to a significant shift in the electronic work function of the metals. Thus, for KPFM in liquids the interaction of the liquid medium with the sample surface must as well be considered for quantitative measurements (Figure 1a). Decane for example reduces the work function of Au(111) by around 0.7 eV as found by UPS measurements by Ito and coworkers [3]. After alkane thiol adsorption on Au(111) (Figure 1b) the AM-KPFM measurement revealed a work function shift of the Au by -1.33 eV (Figure 1c). This shift is in good agreement with UPS data reported by Alloway and coworkers [4]. The lowering of the work function is induced by the formation of an interfacial dipole layer which is directed towards the metal surface, i.e. the negative charges are positioned at the metal/ sulfur interface and the positive charges to the air interface.

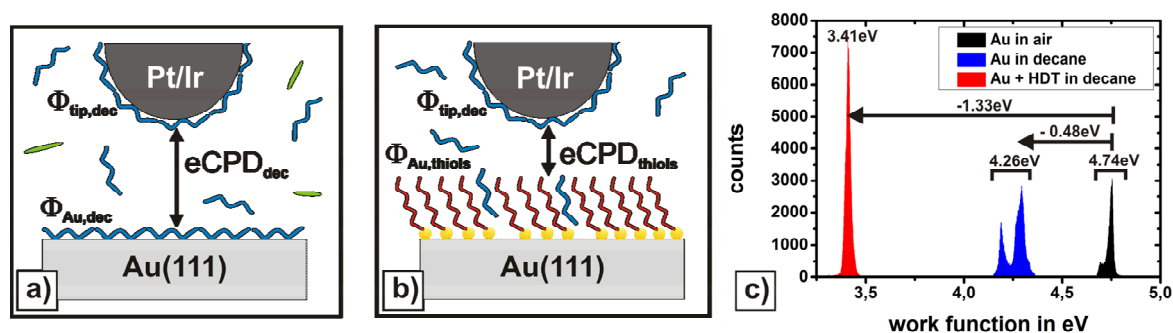


Figure 1: a) Schematic of measurement in decane. Tip and sample are covered by monolayer of physisorbed decane. b) Schematic of measurement on alkanethiol monolayer in decane. c) Histogram of work function measured on the untreated Au(111) surface in ambient air (black), in decane (blue) and on the Au with an adsorbed monolayer of hexadecanethiols in decane (red).

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