

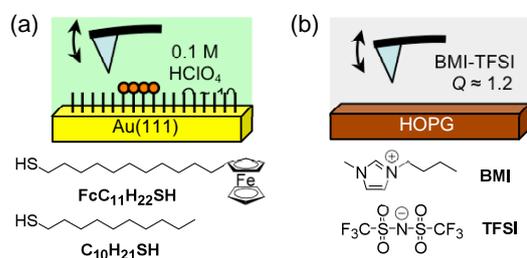
# Solid–Liquid Interfaces Investigated by Using Scanning Probe Microscopy and Photoelectron Spectroscopy

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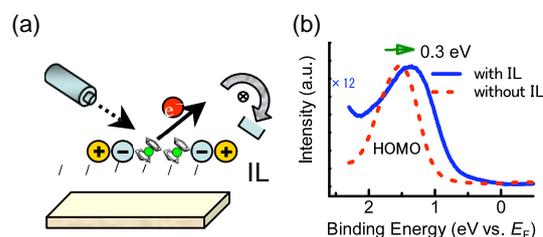
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In the last quarter of century, electrochemist succeeded in developing a molecular picture of the electrified solid–liquid interfaces by using electrochemical STM (EC-STM) [1]. EC-STM, however, has its own limitations; (i) EC-STM images reflect not only the physical topography but the electronic structure, thus complicating the quantitative analysis, and (ii) EC-STM can only detect the information very close to the solid surface (< a few nm). To obtain complementary information and overcome above limitations of EC-STM, we studied two kinds of solid–liquid interfaces, electroactive molecular islands in an aqueous solution (Fig. 1a) [2], and HOPG in ionic liquids (IL) (Fig. 1b) [3], by using frequency-modulation AFM (FM-AFM). In this seminar, the difference between EC-STM and FM-AFM studies is presented and discussed in detail [4].

We also investigated the IL / electroactive self-assembled monolayer (SAM) interfaces by using photoelectron spectroscopy (Fig. 2a). This was intended to reveal the electrostatic potential distribution at the solid–liquid interfaces. Our preliminary results have shown that HOMO level of the electroactive species is shifted to low binding energy as a result of interaction with IL (Fig. 2b). Possible origin of the shift is discussed in the seminar.



**Figure 1:** Schematics of FM-AFM measurements and molecular structures used in this study.  
 (a) FcC<sub>11</sub>H<sub>22</sub>SH islands embedded in C<sub>10</sub>H<sub>21</sub>SH SAM.  
 (b) HOPG immersed in BMI-TFSI ionic liquid.



**Figure 2:** (a) Schematics of photoelectron spectroscopy measurements of IL/electroactive SAM interface. (b) Photoelectron spectra with and without IL adsorption layer.

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