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In-Situ molecular study of bioelectrochemistry using ToF-SIMS

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Dynamic molecular information at electrode-electrolyte interface is critical for a range of scientific fields, including electrocatalysis, electrodeposition, and rechargeable battery. However, it has been a challenge to directly monitor the molecular process at the electrode-electrolyte interface under reaction conditions. For example, the mechanism of electro-oxidation of vitamin C on the anode surface has been hypothesized for quite a few years;1 however, no direct experimental evidence has been reported to support such hypothesis. We recently developed a self-contained microfluidic device (i.e., System for Analysis at the Liquid Vacuum Interface, SALVI) for probing solid-liquid interfaces and demonstrated its feasibility in ToF-SIMS and SEM.2,3 An electrochemical version or the E-cell was also developed by enclosing a three-electrode system in the microreactor, and the E-cell allows us to in situ molecularly monitor electro-oxidation of I- at the electrode-electrolyte interface.4 Recently, we successfully observed the short-lived chemical reaction intermediate of the electro-oxidation of vitamin C on the anode surface; and our new observation provides the first direct experimental evidence to the hypothesized oxidation mechanism. Also, the dynamic change of electric double layers can be monitored in real time.5 Most recently, we have applied our new tool to study electron transfer at the electrode-biofilm interface. Preliminary results in this kind of biointerface will be presented.

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