In Situ Characterization of the Electronic Structure at Solid/Liquid Interface by Potential Dependent IR/Visible Double Resonance Sum Frequency Generation Spectroscopy

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To understand the mechanism and improve the efficiency of processes at solid in liquid phase such as electrochemical reactions, it is essential to know in situ information at solid/liquid interfaces. While many useful techniques applicable to geometric and molecular structure study at solid/liquid interfaces have been developed, in situ techniques to probe the electronic structure at solid/liquid interfaces are still limited because of the difficulty in determining it in liquid. Double resonance sum frequency generation (DR-SFG) spectroscopy, which utilizes resonant enhancement of SFG signal with both frequency-tunable incident IR and visible lights, has been proved to be able to elucidate the electronic structure of CO/Pt interface in UHV,[¹] and it should be applicable to electrochemical interfaces since it is a photon-in photon-out technique.

In the present study, the DR-SFG technique combined with electrochemical method was applied to probe the electronic structure of CO adsorbed on various Pt electrode surfaces, including Pt(111),[²] polycrystalline Pt and Pt thin layers modified Au substrates, in 0.5 M H₂SO₄ electrolyte solution by using visible light of different energies, since CO/Pt interface is the simplest and most studied model system for fundamental studies of many important electrochemical reactions.

References