Effective removal of CO from Pt electrode surface is a key step to improve the efficiency of various electrochemical energy conversion processes, especially direct methanol fuel cell, as CO is a harmful surface poison to Pt catalysts in methanol electro-oxidation. Photons may selectively induce a specific interfacial process and control a surface reaction in a delicate way. Accordingly, the elucidation of photo-induced CO desorption mechanism is quite important for a microscopic understanding of underlying molecular dynamics behavior in surface electro-oxidation reactions. Sum frequency generation (SFG) vibrational spectroscopy, which is a highly surface-sensitive nonlinear optical technique, can not only monitor the fast photo-induced process at the interface, but also can provide surface electronic and molecular structure information, which is not achievable by traditional surface vibrational techniques.

Here, we employed UV/visible pump-SFG probe technique to investigate photo-desorption process of CO on Pt electrode surface at various electrode potentials, where the desorption of CO molecules were induced by UV/visible pump pulses. CO is more easily photo-desorbed from Pt surface when the potential is close to CO oxidation potential. In addition, to better understand the photo-desorption mechanism of CO on Pt electrode, a potential-dependent electronic-vibrational doubly resonance enhancement experiment of CO/Pt was carried out by tuning both incident fundamental lights, i.e., visible and IR, so that precise information on interfacial electronic structure of CO under electrochemical conditions can be obtained.

References: