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Examination of strong interaction between plasmon and molecular exciton by surface enhanced spectroscopy

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Electromagnetic (EM) enhancement of the molecular optical responses close to plasmonic nanostructures used in surface enhanced spectroscopy enables us ultra-sensitive detection and in situ characterization. Recently, the research fields of EM enhancement have entered a new research regime wherein the enhancement effects are connected to plasmon-induced photochemical reactions. For this regime, the theorem used to understand the EM enhancement effect should be re-examined, because such photochemical reactions are beyond the assumptions in the theorem. Thus, the EM mechanism firstly is summarized by using surface-enhanced Raman scattering (SERS), which is the most general optical response using an EM enhancement, and determine the limitations of the EM mechanism in SERS. Secondly, we discuss the necessity of re-examining the EM mechanism with respect to three breakdowns of the approximations in Fermi's golden rule: the breakdown of the molecular electronic dynamics by the ultra-fast plasmonic de-excitation, the breakdown of the weak coupling between the plasmon and molecular exciton by strong EM enhancement, and the breakdown of the selection rule of SERS by the field-gradient effect. These breakdowns allow the observation and control of molecular functions that remain hidden by previous spectroscopic methods.

Biography

Tamitake Itoh has completed his PhD in 2002 from Osaka University and has done postdoctoral studies in Kwansei Gakuin University during 2002 to 2005. He is currently the Senior researcher of National Institute of Advanced Industrial Science and Technology (AIST), Japan. He has published more than 100 papers in reputed journals.

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