Atomic-Scale Optical Spectroscopy at Surfaces

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Optical spectroscopy is a powerful tool for chemical analysis, providing a wealth of information on structure, dynamics, and electronic properties. However, the diffraction limit of light does not allow resolve nanoscale structures. This physical limitation can be overcome by the use of near-field optics. In particular, localized surface plasmon resonance of metal nanostructures yields strong confinement and enhancement of electromagnetic fields, enabling ultrasensitive optical spectroscopy. Surface- and tip-enhanced spectroscopy, benefiting from extreme confinement and enhancement of gap-mode plasmon, has demonstrated nanoscale and even single-molecule spectroscopy [1-3], which will be a promising approach to study surface chemistry such as electrochemistry [4] and heterogeneous catalysis [5]. More recently, tip-enhanced spectroscopy in plasmonic junctions showed optical spectroscopy with sub-molecular resolution [6-9]. This emerging technique will allow for investigation of light-matter interaction at atomic scales [10]. I will discuss our recent development toward atomic-scale optical spectroscopy by a combination of quantum plasmonics with low-temperature scanning tunneling microscopy [11-22].

References

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