学术报告

题 目: From Nanospectroscopy to Biomedicine: Experiments with Raman spectroscopy and related label-free techniques

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固体表面物理化学国家重点实验室
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From Nanospectroscopy to Biomedicine: Experiments with Raman spectroscopy and related label-free techniques

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Abstract:

Our research is at the interface of spectroscopy, nanomaterials and biomedicine. In this talk I will describe the work on two major interdisciplinary themes in my group of biospectroscopy and label-free imaging. The aim of the biospectroscopy strand of our research is to gain an understanding of biochemical phenomena inside cells and especially obtain information which cannot be provided by current prevalent techniques. We use the highly sensitive molecular 'finger-printing' technique of surface-enhanced Raman spectroscopy (SERS) which relies on nanoscale metallic materials to massively increase the otherwise weak spectroscopic signals. We have studied SERS extensively which includes recent work on using single nanoparticle probes in non-conventional ways [1-5]. In the case of biological cells gold nanoparticle probes are voluntarily taken up by them and report on the immediate chemical environment around them when they are inside. This SERS nanoparticle probe approach is made even more powerful by the appropriate functionalization of nanoparticles making them biocompatible as well as allowing the targeting of different organelles. We have shown that such biochemical information provided by SERS allows distinction between closely related cell types and between diseased and healthy cells [6, 7]. This strategy can also serve as an extremely sensitive methodology for monitoring uptake of molecules (small molecules rather than proteins) inside organelles in live cells. Although this highly sensitive, real-time chemical sensing capability is unparalleled by any other technique further developments in nanomaterials for SERS are expected to further strengthen this strategy.

In the second part of the talk I will describe our work to develop and apply label-free imaging techniques to biomedicine. Microscopic techniques based on coherent anti-Stokes Raman scattering (CARS) and second harmonic generation (SHG) are chemically and structurally selective and can be used to rapidly image cells in their native state without any fluorescent labelling or staining. We have applied these techniques to cells and tissues to develop assays for determining the efficacy of drugs [8] and studying differentiation behaviour of stem cells. Recent studies have been on live organisms to correlate metabolic processes to behaviour and on ex vivo tissue samples to track development of respiratory diseases. The ultimate aim is to develop 'imaging diagnostics' for use in clinical and healthcare settings.

References

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