****

臺灣大學應用力學研究所
演 講 公 告

****

主 講 人：王俊凱研究員
臺灣大學凝態科學研究中心

講　　題：表面增強拉曼光譜技術及其應用

主 持 人： 陳國慶所長

時　　間： 112年3月13日（星期一）下午2時20分開始

地　　點： 臺灣大學應用力學研究所國際會議廳

☆☆ 歡迎聽講，敬請張貼 ☆☆

Surface-Enhanced Raman Scattering: Historical Recapitulation and New Developments

Juen-Kai Wang
Center for Condensed Matter Sciences, National Taiwan University and Institute of Atomic and Molecular Sciences, Academia Sinica, Taipei, Taiwan, ROC
jkwang@ntu.edu.tw

Plasmonics has emerged as an attracting scientific realm in past two decades owing to its anomalous optical properties (both in near- and far-field) and its potential applications in sensing, display, and solar energy. Taking advantage of the plasmon-enhanced local field in proximity of metallic nanostructures, surface-enhanced Raman scattering (SERS) provides potential to detect chemical and biological traces. We have developed a two-dimensional SERS-active substrate which confers highly uniform, reliable Raman enhancing ability, enabling many sensing applications. These advantageous characteristics are enabled by high-density, uniform, stable Ag nanoparticles configured as a closely packed array within anodic aluminum oxide (AAO) nanochannels, thus producing enhanced local field residing between adjacent nanoparticles separated by sub-10 nm gap [1]. Its fundamental electromagnetic enhancement mechanism was studied with far-field and near-field optical characterization tools as well as with high-precision electrodynamic calculation [2].

In this presentation, I will show the development of a high-speed detection platform based on this SERS-active substrate and its four critical sensing applications in food adulteration, environmental pollution and clinical microbiology. First, adulterated Cu chlorophyll in vegetable oils was detected by this platform with a limit of detection of 0.5 ppm. The faked olive oils could be spotted on site within minutes [3] which are in contrast to days needed with conventional hyphenated analytic methods that are performed in designated laboratories. Second, highly toxic hexavalent chromium and cyanide in industrial effluent water were identified within half a day, enabling high-speed screening and on-site monitoring [4]. Third, a newly developed classification method (SLDA), separating specific features from fluctuation in data, effectively speciated the characteristic SERS spectra of different mycobacteria species, better than conventional classification methods [5], providing a simple way to differentiate *Mycobacterium tuberculosis* from non-tuberculosis mycobacteria. Fourth, characteristic SERS signatures of bacteria were used as biomarkers for antimicrobial susceptibility testing [6]. The results were obtained within four hours and thus provided timely information for antimicrobial administration of patients.

References

[1] H.-H. Wang *et al*., Adv. Mater. 18. 491 (2006).
[2] S. Birin *et al*., Opt. Express 16, 15312 (2008); B.-Y. Lin *et al*., Opt. Express 17, 14211 (2009); T.-Y. Cheng *et al*., Phys. Chem. Chem. Phys. 15, 4275 (2013).
[3] N.-W Lien *et al*., Food Addit. Contam. 32, 627 (2015).
[4] O. Dvoynenko et al., ACS Omega 6, 2052 (2021).
[5] W.-C. Cheng *et al*., Anal. Chem. 93, 2785 (2021).
[6] C.-Y. Liu *et al*., Sci. Rep. 6, 23375 (2016); Y.-Y. Han *et al*., Sci. Rep. 10, 12538 (2020).