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Silica Coated Gold Nanorod Supraparticles: a Tunable Platform for Surface Enhanced Raman Spectroscopy

Gold nanorod (AuNR) based assemblies are promising functional materials for Surface Enhanced Raman Spectroscopy (SERS) due to the shape induced tunable localized surface plasmon resonance (LSPR) of AuNRs. Designing the optimal assembly structure for SERS, however, is challenging and requires a delicate balance between the interparticle distance, porosity and wetting of the assembly. Here, we introduce a new platform of AuNR assemblies for sensing utilizing their collective ensemble properties. Our design relies on a solvent evaporation approach to assemble silica coated gold nanorods (Au@SiO_2 NRs) dispersed in emulsion droplets into spherical supraparticles in which the thickness and porosity of the silica shell are exploited to control the plasmonic coupling between the AuNRs and the mass-transport through the supraparticle, respectively. Moreover, etching the AuNRs inside their mesoporous silica shells allows fine-tuning of the plasmonic response to the laser excitation wavelength. The SERS performance of various supraparticles was investigated as a function of the assembly porosity, interparticle distance, and LSPR of the AuNRs using a novel correlative SERS-electron microscopy approach. Altogether, the Au@SiO_2 NR supraparticles introduced in this work present a novel class of materials for sensing, and opens up a wide parameter space to optimize performance and use in heterogeneous catalysis.

References

[1] J. E. S. van der Hoeven, H. Gurunarayanan, M. Bransen, D. A. Matthijs de Winter, P. E. de Jongh, A. van Blaaderen, Adv. Funct. Mater., 2022, 22001458
[2] J. E. S. van der Hoeven, T. S. Deng, W. Albrecht, L. A. Olthof, M. A. van Huis, P. E. de Jongh, A. van Blaaderen, ACS Omega, 2021, 7034
[3] T. S. Deng, J. E. S. van der Hoeven, A. O. Yalcin, H. W. Zandbergen, M. A. van Huis, A. van Blaaderen, Chem. Mater., 2015, 7196

Figures

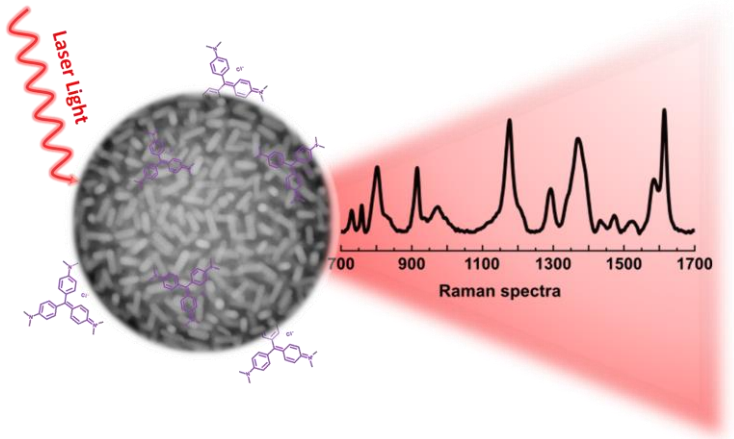

Figure 1: Silica coated Au nanorod supraparticles for SERS