Nanogap-Enhanced Raman Scattering (NERS)

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Started from the simple wet-chemical nanogap generation induced by Coulomb aggregation among colloidal nanoparticles in aqueous solution after adding salt onto it shown independently by S. Nie and K. Kneipp in 1997, nanogap engineering to enhance Raman scattering signal to achieve single molecule sensitivity is getting more sophisticated. In this talk, single molecule Surface-Enhanced Raman Scattering (smSERS) field formed since 1997 will be briefly reviewed and then different types of nanogap engineering strategy for smSERS developed in my lab will be discussed: single-junction 0-D external nanogap between two spherical nanoparticles connected with a double helix DNA (Nature Materials 2010), multi-junction 3-D spherical nanogap internally formed between spherical gold core nanoparticle and spherical gold shell nanoparticle connected by multiple single helix DNAs(Nature Nanotech. 2011), and 2-D nanogap arrays formed on a 4-inch polymer wafer by simple two-step process. Several reasons will be discussed why now SERS regime and NERS (Nanogap-enhanced Raman Scattering) regime should be separated on the enhancement factor (EF) distribution histogram. Recent result including direct near-field visualization of the nanogap field of the 2-D nanogap array, single molecule behavior of cytochrome C protein's Raman signal, and ultra-uniform distribution of SERS enhancement factor (EF) of benzene thiol molecule dispersed on this plasmonic 2-D nanogap array wafer will be presented.

List of Publications Related to this Presentation

1. D. Lim, K.-S. Jeon, H.M. Kim, J.-M. Nam*, and Y.D. Suh*, Nature Materials 9, 60 (2010)
2. D. Lim, K.-S. Jeon, J.H. Hwang, H.Y. Kim, S.H. Kwon, Y.D. Suh*, and J.-M. Nam*, Nature Nanotechnology 6, 452 (2011)
3. J.-H. Lee, J.-M. Nam*, K.-S. Jeon, D. Lim, H. Kim, S. Kwon, H.M. Lee, and Y.D. Suh*, ACS Nano 6, 9574 (2012)
4. H.M. Lee, J.-H. Lee, H.M. Kim, S.M. Jin, H.S. Park, J.-M. Nam*, and Y.D. Suh*, Phys. Chem. Chem. Phys. 15, 4243 (2013)
5. H.M. Lee, S.M. Jim, H.M. Kim, and Y.D. Suh*, Phys. Chem. Chem. Phys. (invited review article) 15, 5276 (2013)
6. H. Lee, J.-H. Lee, S.M. Jin, Y.D. Suh*, and J.M. Nam*, Nano Letters, 13, 6113 (2013)
7. H. Lee, G.-H. Kim, J.-H. Lee, N.H. Kim, J.-M. Nam*, and Y.D. Suh*, Nano Letters, 15, 4628 (2015)
8. Y.I. Park, J.H. Kim, K.T. Lee, K.S. Jeon, H.B. Na, J.H. Yu, H.M. Kim, N. Lee, S.H. Choi, S.-I. Baik, H. Kim, S.P. Park, B.-J. Park, Y.W. Kim, S.H. Lee, S.-Y. Yoon, I.C. Song, W.K. Moon, Y.D. Suh,* and T. Hyeon*, Adv. Mater. (2009)
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12. Y.I. Park, K.T. Lee, Y.D. Suh*, and T. Hyeon*, Chem. Soc. Rev. (invited review article) 44, 1302 (2015)
13. H. Lee, S.H. Nam, Y.J. Jung, S.-J. Park, J.-M. Kim, Y.D. Suh*, and D.-K. Lim*, J. Mater. Chem. C, 3, 10728 (2015)
14. J. Yun, H. Lee, C. Mun, J. Jahng, W.A. Morrison, D.B. Nowak, T.-S. Bae, H.M. Kim, N.H. Kim, S.H. Nam, G.-H. Lee, D.-H. Kim, S.-G. Park*, and Y.D. Suh*, manuscript in preparation (2016)
15. H.J. Seo, S.H. Nam, H.-J. Im, J.-y. Park, J.Y. Lee, B. Yoo, Y.-S. Lee, J.M. Jeong, T. Hyeon, J. W. Kim, J.S. Lee, I.-J. Jang, J.-Y. Cho, D.W. Hwang*, Y.D. Suh*, and D.S. Lee*, Sci. Report, 5, 15685 (2015)
16. H.S. Park, S.H. Nam, J.W. Kim, H.S, Shin, Y.D. Suh*, and K.S. Hong*, Sci. Report, 6, 27407 (2016)