Fabrication of A Nanodiamond Monolayer for Local Temperature Sensing of Plasmonic Gold Nanoparticles

C. Yang, H. Sun, A. S. Rotelli, R. A. L. Romasanta, A. S. Z. Tan, A. A. Bettiol

Physics Department, National University of Singapore, Singapore, 117542

phyyac@nus.edu.sg

S. Q. Y. Wu, E. J. Teo

Institute of Material Research and Engineering, Singapore, 138634

V. Suresh

WearOptimo Pty Ltd, 14 Hockings St, West End QLD 4101, Australia

Local temperature measurement of a plasmonic planar structure is of great importance to understanding the thermal effect on plasmonic devices in applications such as bio-sensing, imaging and beam shaping. In this work, we demonstrate a method of fabricating a nanodiamond (ND) monolayer on top of a layer of gold nanoparticles to investigate the local temperature change of the gold nanoparticles under optical excitation. The NDs have a high density of nitrogen-vacancy (NV) centers whose spin states are sensitive to temperature and can be optically read-out, thereby they can act as an optical nanothermometer. We show that this method allows a high-resolution thermal imaging of the gold layer. By measuring the temperature of the gold nanoparticles under different laser powers, we show that the heating of an excitation laser can significantly increase the local temperature. This method provides a promising way to study the thermal effect on the performance of plasmonic devices or plasmonic assisted light-matter interaction such as fluorescence enhancement or Purcell effect.