Heat generation in gold nanorods through absorption of broadband supercontinuum light

Wei Tao, Hongchun Bao and Min Gu*
Centre for Micro-Photonics, Faculty of Engineering & Industrial Sciences, Swinburne University of Technology, Hawthorn, Victoria 3122, Australia

*Corresponding author: mgu@swin.edu.au

Gold nanorods (NRs) have been widely used as multifunctional agents in plasmon-assisted imaging and photothermal treatment owing to their biocompatibility and unique optical properties [1]. The heating speed and the heating efficiency of gold NRs directly affect the safety and the time required for photothermal treatment, and the writing speed of optical data storage. Efficient and fast heating of gold NRs have been sought through optimising the pulse width, the energy level, and the polarisation state of an excitation laser beam [2]. The impact of energy, pulse width, circular polarisation and radial polarisation of the excitation laser beam on gold NR heating have been studied [3]. However, the broadband coherent supercontinuum (SC) source, which could be more efficient in heating gold NRs, has not been investigated.

In this study, a linear polarised supercontinuum source generated from a highly birefringent nonlinear photonic crystal fiber (PCF) with two zero-dispersion wavelengths is newly employed for heating gold NRs. The difference of heat generation in gold NRs through absorption of the SC source and femtosecond pulses (FP) is experimentally studied by using transmission electron microscopy (TEM) images and photoluminescence images of gold NRs. The heating speed, which was derived from the quantitative analysis of sizes transformation of gold NRs from TEM images and decreasing of luminescence intensity of gold NRs from photoluminescence images, shows that the gold NRs can be heated more and faster by the broadband SC. The quantitative analysis of sizes transformation of heated NRs from TEM images also shows the difference of NRs in absorption of SC output from the two principle axes of the PCF. We found that dispersive waves and solitons in SC have different heat generation effect in NRs. The discovery shows that SC light could be advantageous in using at plasmon-assisted photothermal treatment and optical data storage.

References