Photothermy of the composite nanoparticles intended for the use in cancer treatment

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Biocompatible plasmonic nanoparticles made of noble metals, such as gold, are widely used in photothermal therapy (PTT) due to their shape- and size-tunable plasmon resonance. Governing high light-to-heat conversion coefficient the nanoparticles could be effective in treating cancer cells by applying intense infrared light [1]. The combination of plasmonic and magnetic properties in composite nanoparticles makes possible to expand the scope of nanoparticles to different areas of cancer treatment, including magnetic hyperthermia, magneto-mechanical therapy and drug-delivery [2].

This work is aimed to demonstrate a method of measuring and extracting the photothermal conversion efficiency of hybrid nanoparticles made of ferromagnetic core in form of tubes and discs covered by thin noble metal layer. The use of ferromagnetic core makes the nanoparticles suitable for manipulation of their concentration, orientation or mechanical motion by external magnetic field, while the outer shell serves as a biocompatible barrier. The colloidal water solutions of nanoparticles of different concentrations were examined in the controlled infrared laser exposition in a custom made photothermal experimental setup. Laser heat induction has been measured by an infrared camera, and the photothermal conversion coefficient has been extracted from the temperature evolution on warming-cooling cycles. As the results of the study showed, the deposition of outer gold shell moderately increases the efficiency of light-to-heat conversion, indicating the possibility of extension of the biocompatible composite nanoparticles studies.

[1] M. R. K. Ali, Y. Wu, and M. A. El-Sayed, J. Phys. Chem. C **123**, 15375 (2019).
[2] C. Naud, C. Thébault, M. Carrière, Y. Hou, R. Morel, F. Berger, B. Diény, and H. Joisten, Nanoscale Adv. **2**, 3632 (2020).