Nanoplasmonics and surface enhanced spectroscopy

"Smart nanocarriers" for drug delivery: application of photothermal plasmonic enhancement

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This work is dedicated to the development of scientific and technological foundations for new methods of controlled targeted drug delivery and release based on regulated photothermal plasmonic enhancement effect in gold nanostructures that are both carriers of drugs and regulators of their release in the body. In the world laboratories, the application of this effect in metal nanoparticles has already been successfully demonstrated for cancer treatment, where laser excitation is used to selectively destroy the tumor cells [1-2]. High-conductive metal nanoparticles under the localized surface plasmon resonance (LSPR) conditions act as nanoscale lenses that focus laser energy into a tiny region surrounding the nanoparticle. The great part of electromagnetic energy transforms into thermal energy that locally heats metal nanoparticles and leads to an increase of the cancer cell temperature of about 15-20 °C higher than physiological one, which is high enough to induce apoptosis. In contrast to these studies, in this work gold nanostructures were developed that can carry drugs (nanocontainers), while the thermal effect was mainly used to trigger drug release at the right time with necessary dosing [3]. For the therapy requiring not only direct thermal treatment, but also the application of chemical drugs or genes, plasmon-enhanced photothermal effects are supplemented by the development of special "smart nanocarriers" that enable delivery of drug/oligonucleotide molecules and their subsequent release after the controlled local irradiation of required area of body.

1. *Stern J. M. et al.* Selective prostate cancer thermal ablation with laser activated gold nanoshells // J. Urol.-2008.-**179**.-P. 748-753.
2. *El-Sayed I. H., Huang X., El-Sayed M. A.* Selective laser photo-thermal therapy of epithelial carcinoma using anti-EGFR antibody conjugated gold nanoparticles // Cancer Lett.-2006.-**239**, N 1.-P. 129-135.
3. *Chegel V. I., Lopatynskyi A. M., Rachkov O. E. et al.* Smart nanocarriers for drug delivery: controllable LSPR tuning // Semiconductor Physics, Quantum Electronics and Optoelectronics.-2016.-**19**, N 4.-P. 358-365.