

Gold nanorods@polystyrenesulphonate nanoparticles as a platform for spasers creation

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Despite numerous articles published every year on gold nanoparticles (GNP) they are still of tremendous interest due to their unique optical, catalytic, electronics properties, etc. The most recent application of gold nanoparticles is their utilization as a resonator in plasmonic nanolasers (spasers) in which GNP are surrounded by a thin layer of an active medium whose emission band overlaps with the spectrum of localized surface plasmons of the metal nanoparticle. Nowadays, the colloid spasers have been created in the form of core-shell structures in which the molecules of an active medium are placed into the mesoporous silica shell surrounding the gold core. Thus, the amount of the dye involved in the generation, and consequently the intensity of generation, is limited to the pore capacity of the silica shell. In this regard yolk-shell particles, due to the large free volume available, are considered to be an outstanding candidate for the spaser creation. Besides, the particles of such an architecture have been used as nanoreactors or biological probes for cancer detection. Here we present a novel method of producing hollow nanoparticles composed of gold nanorods core surrounded with a polymeric shell of polystyrene sulphonate. The proposed approach consists in covering the gold nanorods with silica followed by its slow hydrolysis in an aqueous media with the presence of the polymer. We showed that such particles can be filled with different organic dyes and can be used in spaser applications.

Biography

Roman G Parkhomenko studied chemistry at the Altai State University (chemistry faculty) in Barnaul, Russia from 2005 to 2010. In 2010 he moved to Novosibirsk to start his PhD project in the Nikolaev Institute of Inorganic Chemistry. His doctoral dissertation was conducted under the direction of Prof. I.K. Igumenov and focused on the synthesis of novel series of metal complexes with different organic ligands, the investigation of correlations between structure, morphology, composition of gold layers deposited by MOCVD and regimes of their deposition and precursor type, as well as the development of techniques for the deposition of gold nanoparticles and nanometer-sized films in different porous matrices. After successfully defending his thesis, he started to study composite materials based on metal phthalocyanines and nanoparticles/thin metallic films as well as the surface chemistry of metal nanoparticles and their optical properties for biomedical applications, including the investigation of plasmonic nanolasers (spasers). In 2019 he joined the Nanomaterials group under the leadership of prof. M. Knez where he is currently working. He has strong collaborations with scientific groups in the USA, UK, the Netherlands, Poland, Germany, and other countries. His results were published in 20 scientific publications; his close collaborations with industry have lead to 3 patents related to technological applications of gold nanoparticles. He presented his work in 15 talks (including 2 invited) at international conferences as well as in seminars in Europe, Asia and Russia. He won several upscale grants including Russian presidential scholarship and Marie Skłodowska-Curie individual fellowship.