Magnetoplasmonic nanodomes as a novel structure for biomedical applications

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Advanced nanobiomedical applications have been traditionally based on chemically synthesized inorganic nanoparticles. Here we present a novel type of structure especially suited for diverse biomedical uses: magnetoplasmonic nanodomes. The nanodomes are composed of a combined, magnetic and plasmonic, hemispherical shell deposited onto 100 nm diameter polymer or dielectric beads. The variation of the materials and their thicknesses in the shell enables tuning both the optic and magnetic properties of the nanostructures. The very high plasmonic absorption of the nanodomes in the nearinfrared is used for very efficient local optical heating, i.e., photo-hyperthermia for cancer treatment. The nanodomes magnetic character allows to remotely manipulate them to easily regulate the level of photo-hyperthermia. Moreover, given their asymmetric shape they exhibit strong optic and magnetic anisotropies. Thus, the rotation of the nanodomes using alternating magnetic fields can easily tracked optically using their different absorption depending on the orientation. Since the rotation of the nanoparticles depends strongly on the viscosity of the medium, which in turn depends on the temperature, the optical tracking of the rotation can be used to accurately determine the local temperature around the nanodomes, i.e., nanothermometry. Combining the nanodomes efficient photo-hyperthermia with their nanothermometry capabilities, allows in-situ tracking the efficiency of photo-hyperthermia treatments. Moreover, the same nanodome concept can be extended to confer the beads with drug-loading capabilities, where the shell allows for remote controlled drug delivery, magnetic accumulation, or MRI tacking of the beads.