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MAGNETOPLASMONIC NANODOMES AS A NOVEL STRUCTURE FOR BIOMEDICAL APPLICATIONS

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Advanced nanobiomedical applications have been traditionally based on chemically synthesized, bottom-up, multifunctional core/shell or Janus-type 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 polystyrene beads. The variation of the materials and their thicknesses in the shell enables tuning both the optical and magnetic properties of the nanostructures. For example, Fe magnetic layers lead to in-plane magnetization, while [Co/Au] multilayers result in structures with out-of-plane magnetic anisotropy. Using Au plasmonic layers allows adjusting the plasmonic resonance to be in the near infrared, where the penetration in tissues is maximized. The very high plasmonic absorption of the nanodomes is used for very efficient local optical heating, i.e., photo-hyperthermia for cancer treatment. The magnetic character of the nanodomes allows to remotely manipulate them and thus to easily regulate the level of photo-hyperthermia. Moreover, given their asymmetric shape the nanodomes exhibit a strong optical anisotropy, where the plasmonic resonances parallel and perpendicular to the nanodomes take place at different wave lengths. Moreover, since the nanodomes have magnetic anisotropies, when using alternating magnetic fields they can rotate inside liquids. This rotation can be easily tracked optically using the different absorption of the nanodomes depending on their orientation with respect to the light polarization. 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. Thus, combining the nanodomes efficient photo-hyperthermia with their nanothermometry capabilities, allows in-situ tracking the efficiency of photo-hyperthermia treatments.

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