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Semiconductor and Plasmonic Nanoparticles for Biomedical Applications

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Semiconductor and plasmonic (NPs) exhibit unique optical properties for various biomedical applications. Silicon (Si) NPs (Si-NPs) are especially interesting because they are biocompatible, biodegradable and can be easily prepared by chemical and laser-assisted methods [1,2]. Nanocrystalline Si-NPs can exhibit the photoluminescence (PL) and Raman scattering, which are used for the optical bioimaging [2]. The conventional linear optical methods and nonlinear optical spectroscopy of the second harmonic generation and two-photon excited luminescence are demonstrated to be efficient to monitor Si-NPs in biosystems [3]. Si-NPs in aqueous media act as a light absorber in the visible and near-infrared spectral regions and it is promising for photohyperthermia applications [4]. Si-NPs with impurities and intrinsic electronic states can act as labels in magnetic resonance imaging [5], which is widely used in the diagnosis of cancer. Halloysite nanotubes (HNTs) with immobilized plasmonic (gold and silver) NPs are explored as potential nano-templates for surface-enhanced Raman scattering (SERS) for biosensorics and biophotonics [6]. HNTs with immobilized gold NPs are found to sensitize the photohyperthermia under continuous wave and nanosecond pulsed laser excitation with a photon energy close to the plasmonic resonance. These physical properties of semiconductor and plasmonic NPs are promising for the so-called theranostics (combination of therapy and diagnostics).

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