Light-based nanomedicine for cancer: merging diagnostics and drug-free therapeutics

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The near infrared region of the optical spectrum provides a window into the human body that can be exploited for diagnostics and therapeutics, offering an opportunity to merge these concepts. We have shown that the strong light-absorbing and light-scattering properties of noble metal nanoparticles can be controlled by manipulating their shape: in a core-shell geometry, the metallic shell layer can be easily tuned to this spectral region. This 'nanoshell' geometry has proven to be ideal for enhancing both diagnostic and therapeutic modalities for cancer. Nanoshells can serve as light scattering beacons, strong enhancers of fluorescent markers for optical tomography, and impart a highly effective, targeted therapeutic response via their unparalleled light-to-heat conversion properties. This latter effect has been used to induce cell death and tumor remission in animals at greater than 90% efficacy, and is currently in clinical trials. This nanoparticle platform can be combined with MRI contrast agents for the enhancement of dual imaging modalities, and also shows promise as a light-controlled nonviral vector for intracellular gene delivery.