Plasmonic Magnetic Nanostructure:

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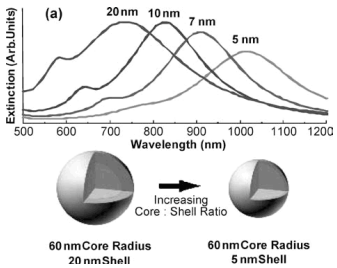
Biomedical Engineering Seminar III
Spring 2009 – Monday, February 23

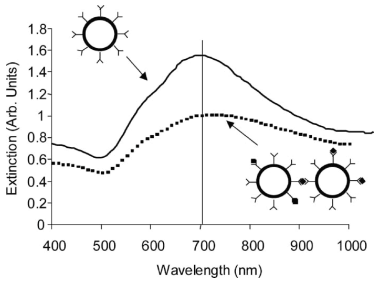
Metal nanoshells are a new type of nanoparticles with a highly tunable plasmon resonance. This allows for the material to be designed to match the wavelength required for a particular application. The optical properties are dependent on the size and composition of each layer of the nanoshell. The particles can then be configured to either scatter or absorb light over a variety of the infrared and visible regions of the electromagnetic spectrum.

A metal nanoshell consists of a spherical dielectric nanoparticle surrounded by an ultrathin, conductive, metallic layer. Gold is a preferred noble metal in biological applications because it is resistant to corrosion, has a low toxicity value, has great conformational flexibility, and allows easy conjugation of proteins onto its surface.

The plasmon resonances can be tuned by changing the ratio of the nanoparticle's core size to its shell thickness. In biological systems, light penetration through tissue is optimal within the near infrared regions (NIR).

An immunoassay is a biochemical test used to find the concentration of a substance in a biological liquid. This process utilizes the antigen-antibody interactions to detect a specific antigen within a complex mixture. When antibody conjugated particles are exposed to a multivalent analyte, multiple particles will bond to the analyte, forming particle dimers and higher order poly-particles. Nanoshell agglutination therefore causes a decrease in the amplitude of the single nanoshell plasmon resonance in the overall spectral response. Hence, by monitoring when there is a decrease in the extinction of the original nanoshell plasmon resonance peak, we can tell when nanoshell-bioconjugate aggregation occurs. A completion of an array only takes about 10 minutes. This is convenient for rapid screening of blood-borne species such as viruses, bacteria, or proteins.





Optically-responsive nanoshell-hydrogel composites are possibly a solution to the challenges faced within the controlled drug delivery field. Nanoshells are entrapped in the thermally response hydrogel. When the NIR light is applied, the nanoshell absorbs the light and generates heat. When the temperature exceeds the lower critical solution temperature (LCST), the polymer chains of the hydrogel collapse causing the expulsion of water and dissolved drug from the matrix. When the temperature falls below the LCST, the polymer chains extend and interact with the water, causing the material to swell.

Photothermal ablation provides a minimally invasive alternative to surgical excision of cancerous tumors. The idea is to inject nanoshells intravenously, allowing them to accumulate at the tumor site before the NIR light is applied. Once accumulated, the NIR light is applied and thus the nanoshell causes heating and destruction of the cancerous cells. There is little damage to the normal surrounding tissues.

Nanoshells can be designed to scatter light rather than absorbing it. Nanoshells thus serve as a strong optical contrast agent for many imaging technologies. In the case of cancer, by imaging specific molecular biomarkers which are present before pathologic changes occur could save lives.

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