Nanotechnology

This research involves the synthesis of nanomaterials such as single walled carbon nanotubes, quantum dots and magnetic fluids for use in medical applications (in combination with dyes such as metallophthalocyanines) and for the development of sensors.

Single-walled carbon nanotubes (SWCNT) are defined as quasi-one-dimensional (1-D) quantum structures. The ability of SWCNT to absorb light in the near-infrared (NIR) region and initiate cell death via a photothermal or photohyperthermia (PHT) effect is of particular interest. Death of cancerous tissue is initiated, since such tissue is sensitive to heat, while normal cells are less affected. PHT is also known to improve the effectiveness of other cancer therapies such as chemotherapy, radiotherapy and photodynamic therapy (PDT).

Quantum dots (QDs) are defined as 0-dimensional semiconductor materials. Recently, QDs have found focus as a new generation of photosensitizers in photodynamic therapy. QDs are capable of transferring energy to ground state molecular oxygen to generate cytotoxic singlet oxygen and thus enhance the efficacy of PDT. The singlet oxygen-generating capabilities of QDs are limited, therefore conjugation of QDs and other nanoparticles such as gold, silver and platinum to a mediating PDT photosensitizer, e.g. a metallophthalocyanine, facilitates the probability of increased PDT efficiency through energy transfer (ET).
Hyperthermia (HPT) is a type of treatment in which body tissue is exposed to high temperatures to damage and kill cancer cells or to make cancer cells more sensitive to the effects of radiation and certain anti-cancer drugs. Hyperthermia (HPT) is, very simply, the application of concentrated therapeutic heat to treat cancer. Malignant cells are more sensitive to heat than normal cells and the raising of temperature is a way to selectively destroy cancer cells. Nanoparticles of magnetic fluids (iron oxide) are used for HPT.