



## Nanotech News

[Back](#)

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### Nanoparticles Open New Avenues for Photodynamic Therapy

Photodynamic therapy, which uses a light-sensitive drug or photosensitizer to produce reactive oxygen that then kills nearby cells, has gained acceptance as a means of treating and relieving the symptoms of esophageal and small-cell lung cancers. It is clear, however, that wider use of photodynamic therapy in clinical oncology will only come when researchers develop more targeted methods of delivering photosensitizers strictly to tumors. Two newly published papers suggest that nanoparticles may provide the means for targeting tumors with photosensitizers.

Writing in the journal *Molecular Pharmaceutics*, a team of investigators at the State University of New York at Buffalo and the Roswell Park Cancer Institute describes its development of a nanocarrier that can be guided to a tumor using a focused magnetic field. Led by [Paras Prasad, Ph.D.](#), who is the principal investigator of one of the National Cancer Institute's [Cancer Nanotechnology Platform Partnerships](#), the researchers used nanoscale fatty particles known as micelles to encapsulate iron oxide nanoparticles and a photosensitizer drug known as HPPH.

The investigators built the micelles using poly(ethylene glycol), or PEG, attached to the lipid phosphatidyl ethanolamine, also known as PE. The lipid portion of this polymer forms the core of micelle and a place for loading therapeutic amounts of the fat-soluble photosensitizer. The PEG segment creates a water-soluble outer layer that stabilizes the micelle in aqueous environments such as the bloodstream. The PEG coating also readily incorporates iron oxide nanoparticles and creates a protective coating that shields the resulting particles from being removed from the bloodstream by the body's reticuloendothelial system.

Determining the optimal composition of the targeted, drug-loaded micelles proved to require extensive experimentation, but the result was a stable nanocarrier that turned out to be more efficient at generating reactive oxygen than the photosensitizer alone. Tumor cells readily took up the micelles within 90 minutes and were killed when irradiated with light. In the absence of light the nanocarriers were not toxic to the cells. Applying a local magnetic field to the culture dish led to uptake only by those cells within the magnetic field.

In a second report, published in the *Journal of the American Chemical Society*, a research team at the California State University at Los Angeles, led by Matthias Selke, Ph.D., describes its construction of water-soluble quantum dots attached to an organic dye. This nanocomposite is composed of cadmium telluride quantum dots coated with a water-solubilizing surface stabilizer and linked to a photosensitizer known as TSPP.

Optical experiments with this nanocomposite showed that near-ultraviolet and visible light

absorbed by the quantum dots transferred efficiently to the photosensitizer, resulting in reactive oxygen production at levels that would be sufficiently high for therapeutic applications. The composite was stable in the presence of reactive oxygen, an important consideration for clinical use. Given that other investigators have recently shown that quantum dots can be delivered selectively to tumors using targeting molecules (click [here](#) for earlier story), these results could lead to new advances in photodynamic therapy for treating cancer.

The work on magnetically guided photodynamic therapy, supported in part by the National Cancer Institute, is detailed in a paper titled, "Diacyllipid micelle-based nanocarrier for magnetically guided delivery of drugs in photodynamic therapy." This paper was published online in advance of print publication. An abstract of this paper is available at the journal's website.

[View abstract.](#)

The work on quantum dots is detailed in a paper titled, "Singlet oxygen generation from water-soluble quantum dot-organic dye nanocomposites." An abstract of this paper is available through PubMed.

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