

## ***Photon Upconverting Nanoparticle-based Photosensitizers for Photodynamic Therapy***

Peng Zhang, Wim Steelant, Manoj Kumar, Matthew Scholfield. Department of Chemistry, New Mexico Tech, Socorro, New Mexico 87801

**Background and Objective:** Photodynamic therapy (PDT) is gaining acceptance as a technique for cancer treatment. A key component in effective and efficient PDT is the photosensitizers. Here we report the design of a type of versatile photosensitizers based on photon upconverting nanoparticles (PUNPs). Photon upconverting materials convert lower-energy light to higher-energy light through multiple photon process. We take advantage of the fact that such materials would adsorb infrared irradiation and emit visible light to further excite the photosensitizing molecules.

**Methods:** PUNPs ( $\text{NaYF}_4:\text{Yb}^{3+},\text{Er}^{3+}$  nanoparticles) were first coated with a porous, thin layer of silica. Photosensitizing molecules (Merocyanine 540) were doped into the silica layer during the coating process. Finally, anti-MUC1/episialin, an antibody specific to antigens expressed on the MCF-7/AZ breast cancer cell surface, was covalently attached to the silica-coated nanoparticles.

**Results:** Generation of singlet oxygen by these photosensitizers was detected spectroscopically. *In vitro* PDT tests were performed to confirm the photodynamic cytotoxicity of the photosensitizers towards MCF-7/AZ breast cancer cells.

**Discussion and Conclusions:** Results demonstrated that such photosensitizers have great potential to become the next generation PDT drugs. They display the following advantages: 1) Excitable by infrared light sources. 2) Highly specific. 3) Versatile.

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