Novel Design of Water Soluble Porphyrin Containing Supramolecular Complex Nanoparticles for Enhanced Photodynamic Cancer Therapy

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Photodynamic cancer therapy (PDT) is an emerging technology that treats a variety of cancers without any side effects. In PDT, photosensitizers accumulated near cancer tumors are activated to excited states from the ground state by shining a light. When photosensitizers return to ground state they deliver energy to the surrounding molecular oxygen and excite them to singlet oxygen states. These singlet oxygen species are very reactive and destroy the cancer cells. Functionalized porphyrinic nanostructures are emerging as suitable multifunctional photosensitizers for PDT because of their photochemical and photophysical properties. However, the developments of such architectures in water provide a challenging task, because of their tendency to form ill-defined aggregates. Hence, synthesizing water soluble nanostructures without any aggregates is emerging as an important research focus. In this project, water soluble porphyrin spherical nanoparticles composed of a supramolecular complex between Tetrakis(N-methyl-4-pyridyl)-porphyrin (TMPyP), cucurbit[7]uril (CB[7]), and poly(propylene glycol) monobutyl ether were successfully designed and synthesized. Subsequently, these nanoparticles were characterized using Transmission Electron Microscope (TEM), UV-VIS Spectroscopy, Fluorescence Spectroscopy, and singlet oxygen generation studies. TEM measurements show that these nanoparticles are spherical in shape with mean diameter of 50 to 100 nm. TMPyP-CB[7] complex nanoparticles showed a significantly enhanced increase in fluorescent intensity by 700% and singlet oxygen generation efficiency by 50%, compared to conventional TMPyP nanoparticles. These results clearly show that these new generation nanoparticles can be effectively used in bio-imaging and PDT in the future.

Awards Won:
Third Award of $1,000