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Luminescence nanoparticles for photodynamic activation for Cancer treatment and photosynthesis enhancement

Photodynamic therapy (PDT) is a promising recipe for cancer treatment. However, the difficulty of light penetration into deep tissue has hitherto prevented the application of photodynamic therapy for deep cancer treatment. The three components that are required for PDT are oxygen, photosensitizers and light. It is commonly accepted that singlet oxygen is the predominant cytotoxic agent produced during PDT. Therefore, PDT efficiency is largely determined by the yield of singlet oxygen, which is a product of photosensitizer structure, light absorption characteristics (intensity and wavelength) and oxygen concentration. Light must be delivered to the photosensitizers to activate them. All current porphyrin-derived PDT compounds, such as Photofrin, have a strong absorption band near 400 nm called the Soret band. Unfortunately, attempting to activate porphyrins through absorption at the Soret band is not practical because blue light has minimal penetration into tissue; thus, direct photodynamic therapy is not efficient for deep cancer treatment. To solve the problem of light penetration and to enhance the PDT treatment for deep cancers, I have proposed a new PDT system in which the light is provided by afterglow nanoparticles with attached photosensitizers. When the nanoparticle-photosensitizer conjugates are targeted to tumor and stimulated by X-ray during radiotherapy, the particles will generate light to activate the photosensitizers for photodynamic therapy. Therefore, the radiation and photodynamic therapies are combined and occur simultaneously and the tumor destruction will be more efficient. More importantly, it can be used for deep tumor treatment as X-ray can penetrate deep into the tissue such as Breast and prostate cancers. Here we present the progress of the research in my group on the design, synthesis and evaluation of nanoparticle conjugates for photodynamic therapy. In a similar way, we may use luminescence nanoparticles to convert the unused light to useful light to enhance photosynthesis for crop production

Biography

Wei Chen is a full professor of Nano-Bio Physics at the Physics Department, The University of Texas at Arlington. He received Ph. D. from Peking University. In 2006, he joined UTA as an assistant professor in Nano-Bio Physics and was promoted to associate professor in 2011 and a full professor in 2013. Dr. Chen pioneered the photostimulated luminescence of nanoparticles and the nanoparticle self-lighting photodynamic therapy for cancer treatment. He has been funded by NSF, NIH, DHS, DOE, Army Medical and Air Force Office, DTRA and Industry. He has 11 US patents granted and 10 US patents pending. He has co-authored more than 240 journal publications, 10 invited review articles, 7 book chapters and one edited book. So far, Dr. Chen's publications have been cited more than 10,000 times and his H-index is 49. He received the best paper award from American Scientific Publishers in 2017.

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