Porphysome Nanotechnology and Beyond

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Recently we discovered ‘porphysomes’, the first all-organic nanoparticles with intrinsic multimodal photonic properties and beyond. They are self-assembled from porphyrin-lipid building blocks to form liposome-like nanoparticles (~100 nm diameter). The porphyrin packing density is so high (>80,000 per particle) that they absorb and convert light energy to heat with extremely high efficiency, making them ideal candidates for photothermal therapy and photoacoustic imaging. The large aqueous core of porphysomes could be loaded with drugs, whereas the porphysome bilayer, upon disruption, will enable fluorescence imaging. In addition, porphysome can directly chelate metal ions thus unlocking their potential for PET, MRI and radiation therapy. By changing the way porphyrin-lipid assembles, ultra small porphyrin nanodisc and large porphyrin shell microbubbles (dual photoacoustic/ultrasound probe) were also developed. Further, porphysomes are biocompatible, biodegradable and can be easily scaled up. Compared with classical “all-in-one” nanoparticles containing many functional modules, the simple yet “one-for-all” nature of porphysomes not only confers high potential for clinical translation but also represents a novel approach to the design of multifunctional nanoparticle.