Dragon fruit-like multifunctional probe for cancer precision theranostics

Along with the rapid rhythm of human lives, more and more fatal diseases have been surprisingly invading public health. Health is the greatest wealth, health is not equal to everything, but lose health will lose everything. Aside from maintaining a healthy lifestyle (scientific diet & exercise), it's very significant to perform annual medical examination, because early diagnosis of many diseases (such as cancer) makes considerable roles in prognosis and treatment guidance.

So how to diagnose the disease? The research of molecular imaging techniques have presented promising potential to realize this goal. Especially, multimodal imaging provides comprehensive information and accomplishes synergistic advantages over any single modality alone, but it's not easy to find such a multifunctional material. Thanks to the development of nanotechnology, it has offered numerous opportunity for preparing multifunctional nanomaterials with unique chemical and physical properties, however, it is usually tough to satisfy required demands and avoid intrinsic limitations at the same time. The typical case is that many synthetic nanoparticles can be made of controllable size and shape, but accompanies moderate biocompatibility and poor *in vivo* stability. On the contrary, materials from nature usually show amazing performance that perfectly matches human body, such like self-repairing, self-building and self-regulating.

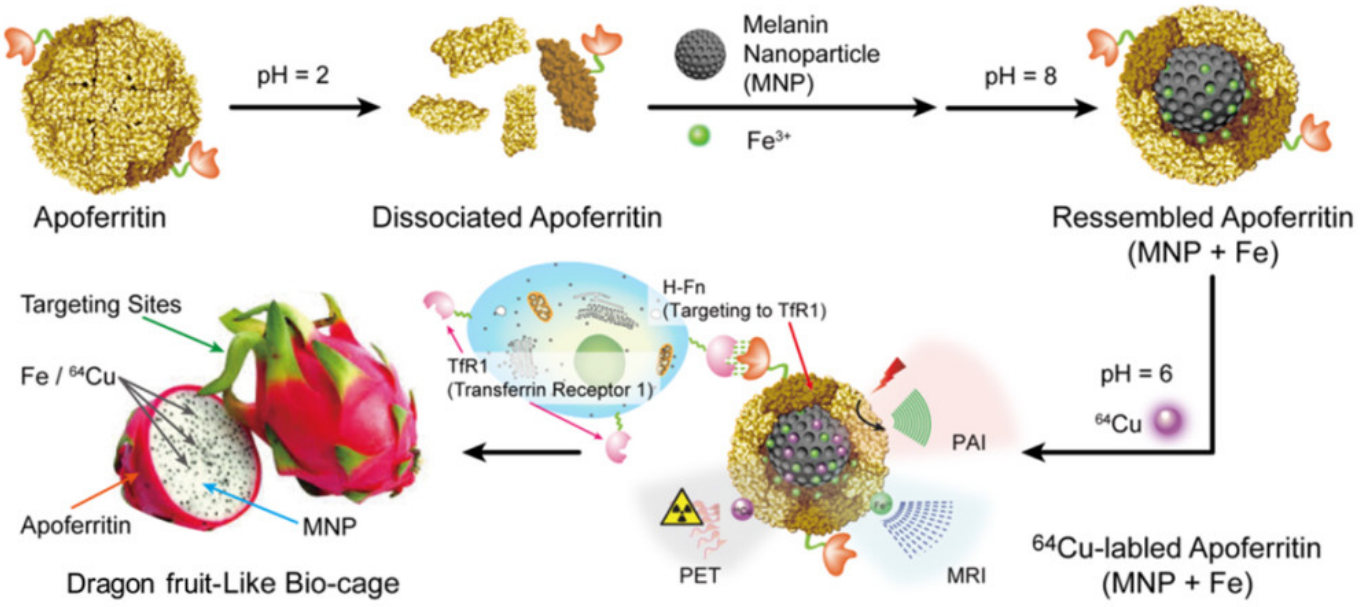

Fig. 1. Schematic illustration of Dragon fruit-Like multifunctional probe

Therefore, natural multifunctional nanomaterials are perfect candidates for multimodality imaging and therapeutic applications. Conventional methods of building multimodal imaging probes require either cross-linking to increase *in vivo* stability or covalently attach a target module to realize targeted imaging. In this study, we remedy these problems by utilizing two kinds of natural nanomaterials — melanin nanoparticle (MNP) and apoferrintin (APF). Melanin is natural biopolymer that is widely present in human body and has traditionally served as a biomarker for melanoma detection and therapy because of its intrinsic photoacoustic signals and the native strong chelating properties with metal ions. Ferritin is a natural iron storage protein. It shows cage-like structure with small size (around 10 nm), multi-channels (