Targeted *in vivo* imaging of microscopic tumors with ferritin-based nanoprobes across biological barriers

With the support by the National Natural Science Foundation of China and the Chinese Academy of Sciences, Prof. Pan's biomineralization laboratory at the Institute of Geology and Geophysics, Chinese Academy of Sciences, has successfully synthesized and recently reported ferritin-based nanoprobes for targeted *in vivo* imaging of microscopic (<1—2 mm) tumors, which was published in *Advanced Materials* (2014, 26(16): 2566—2571).

One of the major obstacles in clinical cancer intervention is the *in vivo* detection of tumors at early stages, when the cancer is still confined to the site of origin and timely preventative treatment is possible. In this study, researchers from Pan's group and collaborators biomimetically synthesized two nanoprobes based on recombinant human H-chain ferritin (HFn): Cy5.5-HFn, an HFn cage labeled with the near-infrared emitting dye Cy5.5 (~8 molecules/cage) as a near-infrared fluorescence (NIRF) imaging contrast agent; and magnetoferritin (M-HFn), containing an HFn cavity loaded with a strongly ferrimagnetic iron oxide core as the magnetic resonance imaging (MRI) contrast agent with high relaxivity (r_2) of up to 224 $mM^{-1}s^{-1}$. They experimentally well demonstrated that those biomimetic HFn-based nanoprobes can be used as reporters for the *in vivo* detection of microscopic breast and brain tumors by NIRF and MR imaging techniques. After intravenous injection, the HFn-based nanoparticles could intrinsically cross serial biological barriers (endothelium, epithelium and blood-brain barrier) and target to tumor cells overexpressed transferrin receptor 1 (TfR1), which makes *in vivo* imaging microscopic tumors possible. They found that the specific binding and endocytosis of M-HFn nanoparticles by tumor cells cause a notable MR contrast enhancement on T_2-weighted and T_2^*-weighted MR images in microscopic tumor areas by about 2 h post-injection. The results indicate that HFn-based nanoparticles may provide a universal probe for early detection of tumors *in vivo* and have a great potential for application in clinical practice.

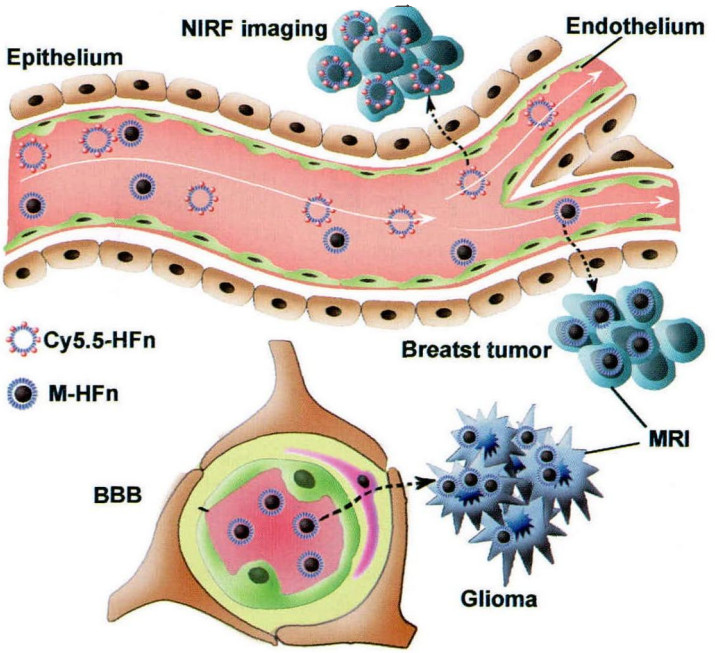

Figure A model depicting the mechanism of HFn-based nanoprobes crossing *in vivo* biological barriers for NIRF imaging and MRI of microscopic tumors.