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Preparation of functional nanogels for tumor imaging and therapy

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Nanogels (NGs), physically or chemically cross-linked colloidal polymer networks, are hydrogels having a size in nanoscale and having combined properties of both nanoparticles (NPs) and bulk hydrogels. Their attractive properties afford their uses in a wide variety of biomedical fields. This talk will be focused on the recent progresses of the synthesis and functionalization of polymer NGs such as γ -polyglutamic acid (γ -PGA), alginate (AG), and poly(N-vinyl caprolactam) (PVCL) NGs for magnetic resonance (MR) imaging, computed tomography (CT) imaging, and photoacoustic (PA) imaging and photothermal therapy (PTT) of tumors performed in our group at Donghua University. In particular, γ -PGA and AG NGs formed via a double emulsion approach can be loaded with Fe₃O₄ nanoparticles (NPs), Mn₃O₄ NPs or Au NPs prestabilized by polyethylenimine (PEI) via an EDC-mediated crosslinking reaction for enhanced MR imaging or CT imaging of tumors. PVCL NGs formed via a precipitation polymerization method can be functionalized with DOTA(Gd) chelator for enhanced T₁-weighted MR imaging of tumors. In addition, we also prove that γ -PGA NGs can be used as a nanoreactor to bind aniline or pyrrole monomer for subsequent redox-mediated polymerization to generate polyaniline (PANI)- or polypyrrole (PPy)-loaded composite NGs that can be used as a unique platform for PA imaging-guided PTT of tumors. By further combination of radiotherapy, the developed PPy-loaded NGs can be used for enhanced PTT of tumors. Overall, through judicious design of functional NGs, various functional platforms may be developed for tumor imaging and therapy, which will bring broad interest for personalized medicinal applications.

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