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Engineered clay nanoparticles for cancer treatment and diagnosis

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Recent progress in material chemistry has enabled scientists to combine therapeutic and diagnostic agents on a single nanoplatform, which is designated as theranostics. However, it remains a challenge to achieve theranostics with safety and high performance. We utilize a clay nanosheet LDH as the carrier of Mn(II) and anti-cancer drug 5-FU and synthesized a new nanocomposite with outstanding pH-ultrasensitive T1-MRI performance and enhanced drug delivery efficiency. Mn(II) element was doped in LDH nanostructure by isomorphic substitution to synthesis Mn-LDH nanosheets. The generated Mn-LDH (~50nm) showed an ultrahigh T1-weighted relaxivity of 9.48 $mM^{-1}s^{-1}$ at pH 5, possibly caused by the unique microstructure of Mn ions in Mn-LDHs. The relaxivity of Mn-LDH was highly sensitive to pH, which increased sixfold when pH was reduced from 7.4 to 7.0. The Mn-LDH was effectively internalized in HT29 cells and the anti-cancer efficiency of 5-FU was enhanced by LDH delivery (IC50=1.54 μg/ml). The *in vivo* MRI evaluation showed an accumulation of Mn-LDH in tumor compared with liver and kidney and the MRI signal maintained in tumor for 72 hrs. The second part of this talk will present a Mn-LDH@SPION(manganese-containing layered double hydroxide@superparamagnetic iron oxide nanoparticles) nanocomposite as a pH-sensitive T1/T2 dual modal MRI contrast agent, hyperthermia agent and efficient drug carrier. The nanocomposite showed T1-weighted relaxivity increased from 1.88 to 6.23 $mM^{-1}s^{-1}$ and T2-weighted relaxivity from 226.18 to 367.25 $mM^{-1}s^{-1}$. This pH-sensitive and high relaxivity is not found in SPION as T2-MRI contrast agent. The Mn-LDH@SPION nanocomposite also has mild hyperthermia and efficient drug delivery properties.

Biography

Zi Sophia Gu is a Lecturer and was a Fellow in National Health and Medical Research Council (NHMRC) in the School of Chemical Engineering at University of New South Wales (UNSW), Sydney. She has obtained PhD from Australian Institute for Bioengineering and Nanotechnology at The University of Queensland, Australia, in 2011 and she was awarded a NHMRC EC Fellowship in 2013 when she started her independent research at UQ prior to joining UNSW in 2016. She has been working in multidisciplinary research areas that combine the knowledge and skills across nanotechnology and biomedicine and has developed a targeted anti-restenotic therapy and built inorganic nanoparticle platforms for diagnosing and treating diseases. She published in high-impact journals including *Advanced Materials, Biomaterials, Chemistry of Materials, Materials Horizons* and *Journal of Controlled Release*, etc. Her recent awards include The Monash Engineering Women's Leadership Award and Deputy Vice-Chancellor (Academic) Award. Her research group focuses on developing multifunctional nanomaterials for theranostic application (disease therapy and diagnosis).

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