Redox-triggered, self-disassembled silica-based nanoplatform for intracellular imaging and drug delivery

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Abstract With the advent of nanobiotechnology, research on cancer treatments has taken a new dimension, called theranostics, which combines diagnostics and therapeutics to improve the management of healthcare in clinics. In this regime, the development of molecular diagnostic tools and targeted therapeutics is inter-connected, aiming at smart drug release. Here we fabricated a redox-responsive silica (ReSi)-based nanoplatform, of which self-disassembly could be triggered by intracellular thiols.

We employed both the ReSi nanosphere and ReSi-functionalized gold nanoparticle (Au NPs) to demonstrate the drug delivery in liver carcinoma Hep G2 cells. The ReSi nanoshell exhibited tunable release of encapsulated drugs. At low GSH level (< 0.1 mM) only minute drug release occurred while at high intracellular GSH level (~1-10 mM) the destruction of disulfide-linked nanostructure was accelerated, leading to rapid release of large amount of drugs. Moreover, redox-responsive drug release could be monitored *in situ* by tracing the sites where fluorescence recovery and Au NPs aggregation occurred due to the destruction of the networks. While it is relatively insensitive to minute amount of redox-active molecules; high intracellular GSH level could trigger the destruction of disulfide-linked silica nanoshell, resulting in an enhanced “Off−On” drug release. Our constructed redox-responsive nanocarrier enables the optimization of drug efficacy with minimizing side effects and shall assist in improving the drug formulation and development process. This system provides great benefit for targeted drug delivery with high spatial/temporal resolution. Furthermore, we expect the Au NP-assisted SERS optical monitoring and its future potential in photothermal therapeutics.

References

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