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Dextran-driven hyperbranched black gold nanoparticles templated by guanosine quartets as broadband absorbers for photothermal therapy

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A B S T R A C T

We report a straightforward aqueous synthesis of black gold nanoassemblies based on supramolecular guanosine quartet (G4) assembly and a dextran co-matrix, in which the functional photothermal component is an interconnected Au(0) plasmonic network. Dextran acts as a multifunctional polymeric co-matrix that helps organize the guanosine moieties and subsequently influences the nucleation and growth environment, particle connectivity, and colloidal stability. In this approach, Au^{3+}/Au^{+} ions play a dual role: beyond serving as metal precursors, they are proposed to stabilize and organize guanosine quartets into an extended Au^{+}-templated G4 supramolecular network, which subsequently acts as a template for gold nucleation, reduction, and assembly into strongly coupled plasmonic architectures. The resulting Au(0) nanoassemblies exhibit intense, nearly black absorption spanning the visible to the NIR-II window (>1064 nm). The optimized dextran-based nanoassemblies show long-term colloidal stability, retain broadband absorption, and generate strong photothermal heating under 1064 nm irradiation, with the optimized samples reaching ~55 °C at 1 W/cm^2 without loss of dispersion stability, whereas the dextran-free analogues destabilize under irradiation. *In vivo* experiments in a mouse air-pouch model showed that macrophages that had internalized the dextran-stabilized gold nanoassemblies were ablated upon NIR irradiation, while the surrounding tissue remained preserved viable, indicating localized photothermal cytotoxicity with minimal collateral damage.

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