

Labeling of HeLa cells using ZrO₂:Yb³⁺-Er³⁺ nanoparticles with upconversion emission

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Abstract

This work reports the synthesis, structural characterization, and optical properties of ZrO₂:Yb(3+)-Er(3+) (2–1 mol%) nanocrystals. The nanoparticles were coated with 3-aminopropyl triethoxysilane (APTES) and further modified with biomolecules, such as Biotin-Anti-rabbit (mouse IgG) and rabbit antibody-AntiKi-67, through a conjugation method. The conjugation was successfully confirmed by Fourier transform infrared, zeta potential, and dynamic light scattering. The internalization of the conjugated nanoparticles in human cervical cancer (HeLa) cells was followed by two-photon confocal microscopy. The ZrO₂:Yb(3+)-Er(3+) nanocrystals exhibited strong red emission under 970-nm excitation. Moreover, the luminescence change due to the addition of APTES molecules and biomolecules on the nanocrystals was also studied. These results demonstrate that ZrO₂:Yb(3+)-Er(3+) nanocrystals can be successfully functionalized with biomolecules to develop platforms for biolabeling and bioimaging.