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Multifunctional nanoparticle for imaging and targeting cellular delivery

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Multifunctional plasmonic nanostructures have enormous potential in the treatment of solid tumours; however, tracking particles with drug cargo and triggering the release of the cargo in mapped tumours is still impossible. To overcome this challenge, we have developed an MRI and fluorescent active nanostructure nanomatryoshka. This new nanostructure with IR plasmonic signatures is composed of a 50 nm Au core surrounded by dye molecules and Gd(III)-DOTA chelate doped SiO₂ inner-shell and an outer Au shell. The experimental results demonstrate an enhanced T1 relaxation ($r_1 \sim 24 \text{ mM}^{-1} \text{ s}^{-1}$ at 4.7 T) compared to the clinical Gd(III)-DOTA chelating agents ($r_1 \sim 4 \text{ mM}^{-1} \text{ s}^{-1}$). Further, this design preserves the fluorescence signal (65%) after 24 hours of exposure, leading to enhanced fluorescence photostability

(23x). This dual-imaging functionality nanosystem increases MRI sensitivity by concentrating Gd(III) ions into the Gd-NMs, reduces the potential toxicity of Gd(III) ions and dye molecules by preventing their release in vivo through the outer Au shell protection, and the terminal gold layer surface can then be functionalized to increase cellular uptake, circulation time, or thermal drug-release properties.

Speaker Biography

Oara Neumann is the J. Evans Atwell-Welch research scientist at Rice University. She has completed her PhD and Postdoctoral study in Applied Physics at Rice University, an MSc in Chemical Physics from Weizmann Institute of Science, Israel and an MSc in Analytical Chemistry from Bucharest University, Romania. She is the pioneer of nanoparticle-based solar thermal applications. She holds several patents and she has published more than 24 referred articles and has an h-index of 16.

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