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Lanthanide cation/complex-dopedγ-maghemite nanoparticles (NPs) - innovative surface engineering (nanoscale drug delivery) towards effective anti-Leishmania bioactivity

Iron oxide (FexOy) nanoparticles (NPs) are widely used in numerous biotechnology applications (magnetism-driven cell separation/cell tracking, magnetic field-guided drug/gene delivery, non-invasive tissue MRI, anti-cancer hyperthermia). But serious drawbacks like challenging detrimental NPs aggregation and controlled NPs surface functionalization versatility request quite innovative solutions. Our recent R&D work in this field led to the discovery of a novel method/concept for promoting (1) the effective anti-aggregation control of 5.0-6.5 nm-sized hydrophilic super-paramagnetic maghemite (γ-Fe2O3) NPs, and (2) its successful use for NPs functionalization/versatile NPs surface engineering toward siRNA-mediated gene delivery/silencing cancer/anti-parasitic therapy-relevant applications. Such an innovative multi-parametric NPs surface engineering methodology exploits both globally optimized controlled design of experiment (DoE) (i) high-power ultrasound (US)-assisted lanthanide metal Ce(III/IV) cation/complex doping, and (ii) polymer/small ligand-based NPs surface coordinative engineering towards innovative drug delivery-relating maghemite NPs. Interestingly, this powerful critical first step $Ce_{3/4+}$ cation/complex-doping process enabled an effective highly positive charge control of problematic NPs aggregation and full NPs water compatibility for a wide range of bio-applications. Quite significantly, it also enables the effective development of versatile surface engineering coordinative linkages/chemistries using well-known effective $Ce_{3/4}$+L_n cation/complex-based coordination capabilities via any potential Lewis basis biomolecule/organic species (hyaluronic/alginic acids, 25 kDa branched polyethyleneimine ($_{25b}$PEI), anti-*Leishmania* pentamidine (Pent) drug, etc.) simultaneous covalent binding.

Biography

Jean Paul Lellouche has completed his PhD degree in 1981 from University Claude Bernard/La Doua, Lyon, France. He then joined the Department of Chemistry/Institute of Nanotechnology and Advanced Materials (BINA) at Bar-Ilan University since October 2000 as Full Professor (Organic Chemis-try/Nano(bio)technology - July 2008) and as Chemistry Department Head (Oct 2017-June 2018). His main R&D activities includes R&D cutting-edge materials science level interfacing with nano(bio)technology. He has authored 154 papers. His main research interests focus on conductive polymers, sol-gel and polymeric surfaces/matrices/NPs, MRI and drug delivery/gene silencing, antibacterial/anti-parasitic nanomaterials and coatings, UV-photoreactive particles for surface nano(micro)structuration of polymeric coatings, catalytic particles (fuel cell technology), and transition metal dichalcogenide nanostructures.

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