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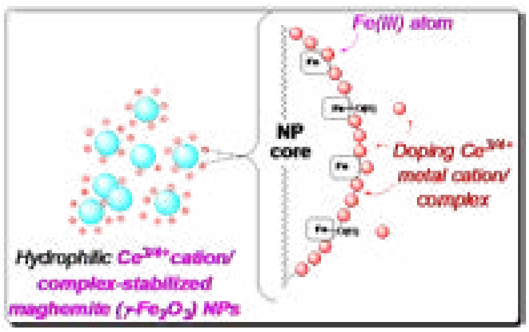
Surface-engineered lanthanide cation-doped γ-maghemite nanoparticles (nps) - innovative nps functionalization/nanoscale drug delivery for effective anti-leishmania bioactivity

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 (i) the effective anti-aggregation control of 5.0-6.5 nm-sized hydrophilic super-paramagnetic maghemite (γ-Fe_2O_3) NPs, and (ii) 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 engineering towards innovative drug delivery-relating maghemite NPs. Interestingly, this powerful critical 1st 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 biological applications. Quite significantly, it also enables the effective development of versatile surface engineering coordinative linkages/chemistries using well-known effective $Ce^{3/4+}$Ln cation/complex-based coordination capabilities via any potential Lewis basis biomolecule/organic species (hyaluronic/alginic acids, 25kDa branched polyethyleneimine ($_{25b}$PEI), anti-Leishmania Pentamidine (Pent) drug, etc.…) simultaneous covalent binding.

This versatile DoE-*globally optimized* NPs surface engineering enabled the discovery of specifically DoE-optimized surface-chemically modified hybrid Pentamidine-containing functional γ-Fe_2O_3 NPs that disclosed highly powerful anti-parasitic (anti-*Leishmania*) bioactivity (both *in vitro/in vivo* effectiveness).[1-3]



Biography

J-P Lellouche (PhD degree, 1981-University Claude Bernard/La Doua, Lyon, France) joined the Department of Chemistry/Institute of Nanotechnology & Advanced Materials (BINA) at Bar-Ilan University since October 2000 as *Full Professor* (Organic Chemistry/Nano(bio)technology - July 2008) & Chemistry Dpt Head (Oct 2017). His main R&D activities includes R&D cutting-edge Materials Science level interfacing with nano(bio)technology. He has authored 149 papers. His main research interests focus on conductive polymers, sol-gel & polymeric surfaces/matrices/NPs, MRI & 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), & transition metal dichalcogenide nanostructures.

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