Isotope Encoded Nanotags for High Sensitivity, Multiplexed Imaging and Detection

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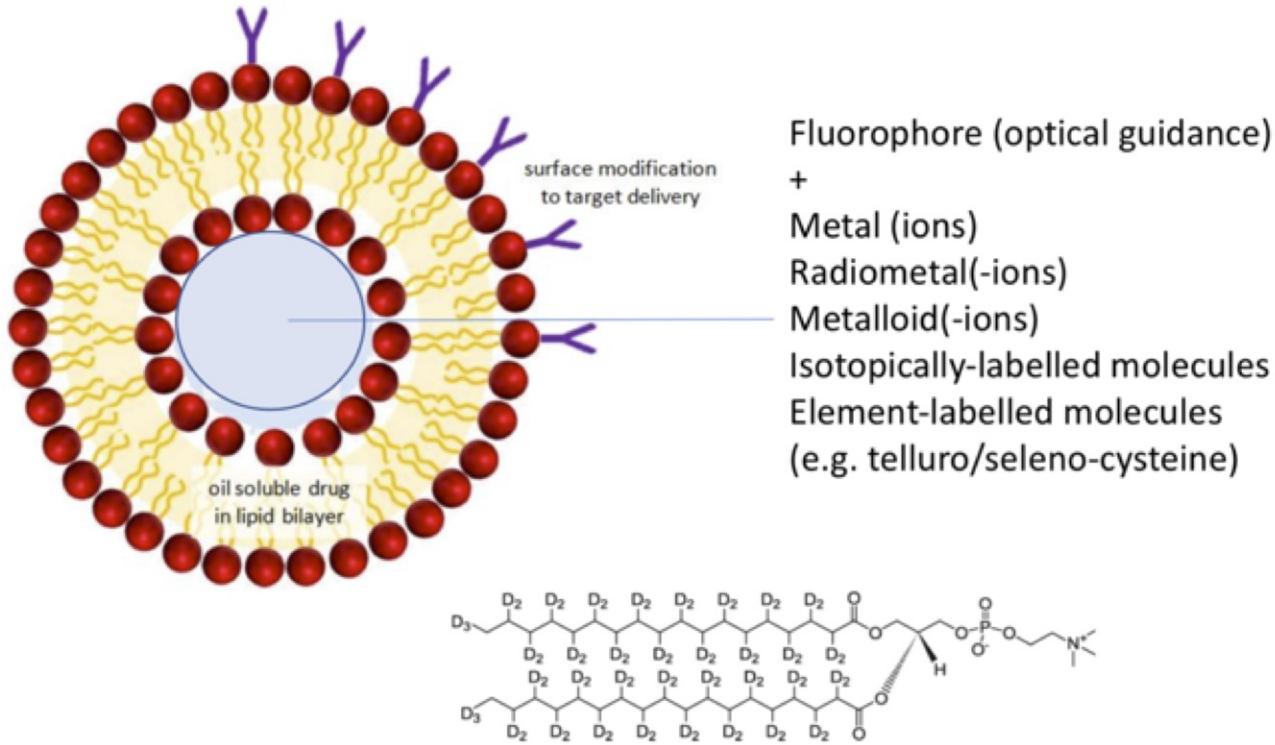
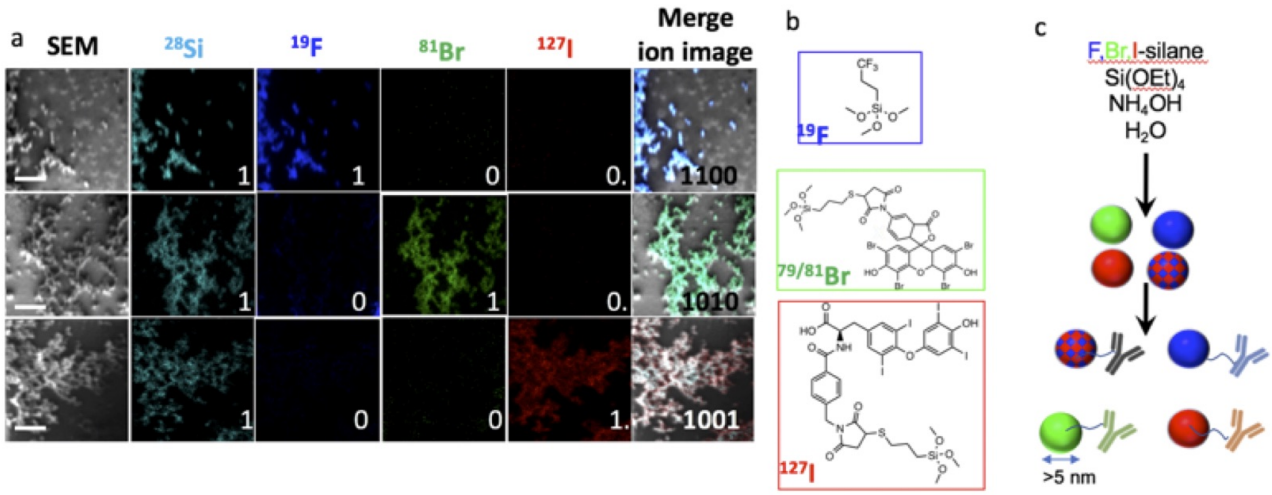
Technology description

Enabling multimodal, high order multiplexing using combined metal- and fluorophore-doped nanoparticle labels in a wide variety of applications such as image-guided surgery, diagnostics, cell tracking, elisa, etc.

Stanford researchers have developed metal and fluorophore doped nanoparticles that act as signal enhancers for multiplexing high-order imaging and detection. The nanoparticles can be inorganics like silica, hafnium oxide, etc., or soft liposomes, micelles, nanobubbles, etc., doped with radioactive metals, non-metals, isotopes, and fluorophores with a wide range of excitation wavelengths (350-1500nm). The isotope encoded nanotags significantly amplify the signal, and facilitate high-sensitivity, multimodal, high order multiplexing for a wide variety of applications such as image-guided surgery, diagnostics, cell tracking, multiplex assays, drug discovery, and anti-counterfeiting.



Isotopcially-encoded soft nanotags. A liposome can be isotopically labeled using isotope-tagged lipids (example is a deuterium- labeled lipid). The aqueous center can be loaded with radioactive, non-metal ions as well as reporters (fluorophores, iron oxides, etc.) or combinations thereof.



NanoSIMS Imaging (MIBI) using Isotopically-encoded nanotagsA) NanoSIMS imaging (MIBI) of isotopically-encoded silica nanoparticles through combinatorial barcoding using 28Si; 19F; 81Br; 127I, respectively. Examples of bare silica ('1000'), fluorine ('1100'), bromine ('1010'), iodine ('1001'), and a combination thereof ('1111'). B) Examples of commercially- available or silane-appended scaffold molecules used to covalently incorporate the different isotopes into the silica nanotag matrix. C) Synthesis of a library of isotopically-encoded nanotags can be labeled with any targeting moiety (antibody, peptide, small molecule) to enable high-parameter multiplexed analyte detection for deep molecular profiling of biological samples.

Application area

Multimodal, high order multiplexing imaging, detection, and diagnostics:
Multiplexed ion-beam imaging (MIBI) Mass Cytometry (CyTOF) Laser-induced breakdown spectroscopy (LIBS) Energy dispersion spectroscopy (EDS) X-ray fluorescence (XRF) imaging Particle-induced X-ray emission (PIXE) Laser-ablation (LA) inductively-coupled mass spectrometry (ICP-MS)
Image-guided surgery
Multi-cell tracking both in a preclinical and clinical setting
Multiplex assays, enzyme-linked immunosorbent assay (ELISA), etc. Anti-Counterfeiting

Advantages

Improved detection limit and multiplex capability - For example, tagging using isotopes of low biological abundance (e.g. 2H, 15N, 19F, 79/81Br, 127I) improves the sensitivity of technologies that use Cs-beams - broadening their application and multiplex capability. Provides a detection label that can be used across multiple platforms (e.g., CyTOF and Fluorescence-activated cell sorting (FACS))

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