

## Abstract:

Upconversion (UC) refers to nonlinear optical process in which the sequential absorption of two or more photons leads to the emission of light at shorter wavelength than the excitation wavelength. Most of efficient UC mechanisms are present in solid-state nanomaterials doped with rare-earth ions. High quality UC nanocrystals can be synthesized via different methods such as thermal decomposition, hydrothermal synthesis and ionic liquid based synthesis, and the UC nanocrystals' solubility, particle size, crystallographic phase, optical properties and shapes can be controlled via altering reagents ratio and reaction conditions. UC nanocrystals have shown great potential for use in photodynamic therapy in cancer treatment, biological labeling and imaging in vivo and in vitro. This has several advantages including the absence of photo damage to living organisms, low auto-fluorescence, less scattering and absorption, high detection sensitivity and deep penetration in biological tissues.

In this presentation, the synthesis and mechanisms of UC nanomaterial-polyethyleneimine (PEI) coated  $\text{NaYF}_4:\text{Yb}$ , Er nanocrystals will be discussed, followed by their applications in different areas, especially in the biological field for imaging.

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