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Editorial Open Access

Applications of Upconversion Nanoparticles in Nanomedicine

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Editorial

Nanotechnology is an emerging technology that provides an extensive range of resources to resolve the health, energy and environmental issues. Nanomaterials hold promising potency to harvest solar energy by tuning their morphological, electronic, optical and surface properties. Meanwhile, these new materials and structures can be fabricated in a low cost and environmentally friendly manner. These materials have wide range of applications including photonics, drug delivery, photocatalysis and bio-medical applications. Different Nanoparticles have been widely studied in recent years because of their unique nanoscale properties, vastly different from those of bulk and have potential applications in various scientific fields.

The concept of photon Upconversion was first discovered by Auzel, Ovsyankin and Feofilov in 1960 [1-3] and this is a non-linear optical effect that can be used to convert low energy incident radiation (infrared light) into higher energy emitted radiation (visible light) via multiple photon absorption steps called excited state absorption (ESA), energy transfer (ET) and photon avalanche (PA) [3]. This kind of optical phenomena has several applications in bio-imaging, lasers, novel display technologies, and solar cells [4]. Upconversion nanoparticles are the special class of nanoparticles (from few nm~100 nm) which have ability to convert near infrared light to visible light by the upconversion mechanism. Among the various upconversion nanoparticles, lanthanide ions (Er3+, Yb3+) doped hexagonal NaYF4 nanocrystals are the most efficient due to their highest upconversion efficiency known to date thanks to their lower crystal symmetry and lower phonon energy [4-7] (Figure 1).

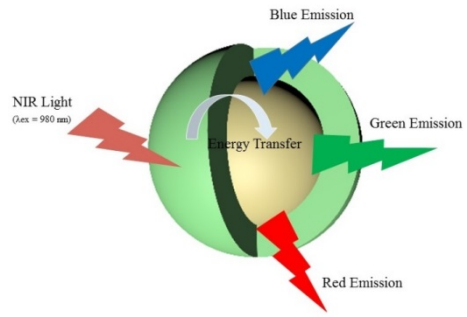

Figure 1: Schematic of a core/shell upconversion nanoparticle showing how NIR light upon 980 nm excitation get upconverted to visible light (blue green and red emission).

These nanoparticles, because of their unique luminescent properties therefore have various potential applications in nanomedicine. They possess several outstanding properties such as high penetration depth into tissues, low noise to signal ratio, higher photostability and good biocompatibility. These nanoparticles are mostly used as bio-labels in modern medical technology and are superior over traditional biomarkers such as organic dyes and quantum dots. Organic dyes and quantum dots have problem of short detection time, low penetration depth, tissue damage, and toxic effects [1,7]. In modern biomedical and nanomedicine, upconversion nanoparticles are used as for bioassyas, biosensing (biosensing of gas molecules and biosensing of metal ions) and temperature sensing in cells. They also have potential use for invitro and invivo toxicity assessment. They are potential materials for cellular imaging such as whole body photoluminescent imaging, optical tomography. They can also be used as multimodal imaging such as upconversion photoluminescence and magnetic resonance imaging (UCPL-MRI) and upconversion photoluminescence and X-ray computed tomography (UCPL-CT) and photo dynamic therapy [5-8].

References

1. Haase M, Schäfer H (2011) Upconverting nanoparticles. Angew Chem Int Ed Engl 50: 5808-5829.
2. Adhikari R, Gyawali G, Cho SH, Narro-García R, Sekino T, et al. (2014) Er3+/Yb3+co-doped Bismuth molybdate nanosheets upconversion photocatalyst with enhanced hotocatalytic activity. Journal of Solid State Chemistry 209: 74-81.
3. Adhikari R, Joshi B, Narro-García R, De la Rosa E, Lee SW (2014) Microwave hydrothermal synthesis and infrared to visible upconversion luminescence of Er3+/Yb3+ co-doped bismuth molybdate nanopowder. Journal of Luminescence 145: 866-871.
4. Wang M, Abbini G, Clevenge A, Mao C, Xu S (2011) Upconversion Nanoparticles: Synthesis, Surface modification and Biological Applications. Nanomedicine: Nanotechnology, Biology, and Medicine 7: 710-729.
5. Adhikari R, Gyawali G, Kim TH, Sekino T, Lee SW (2015) Er3+ loaded barium molybdate nanoparticles: IR to visible spectral upconversion. Materials Letters 142: 7-10.
6. Chang H, Xie J, Zhao B, Liu B, Xu S, et al. (2015) Rare Earth Ion-Doped Upconversion Nanocrystals: Synthesis and Surface Modification. Nanomaterials 5: 1-25.
7. Chen G, Qiu H, Prasad PN, Chen X (2014) Upconversion nanoparticles: design, nanochemistry, and applications in theranostics. Chem Rev 114: 5161-5214.
8. Adhikari R, Choi J, Narro-García R, De la Rosa E, Sekino T, (2014) Understanding the infrared to visible upconversion luminescence properties of Er 3+/Yb 3+ co-doped BaMoO 4 nanocrystals. Journal of Solid State Chemistry 216: 36-41.