6th edition of the International Conference on Materials & Environmental Science, ICMES-2023
June 7-11, 2023, Saïdia – Morocco

Rare Earth Doped Nanoparticles: Towards Theranostics with Light

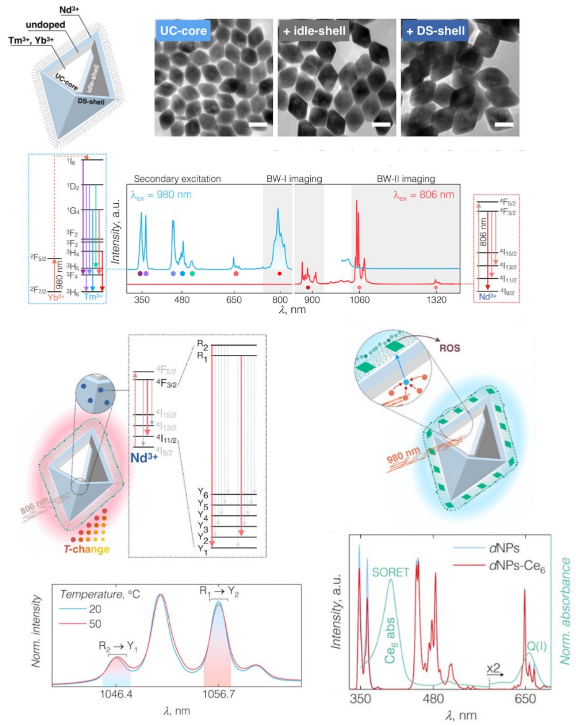
Fiorenzo Vetrone [1]

Institut National de la Recherche Scientifique (INRS), Centre Énergie, Matériaux et Télécommunications, Université du Québec, Varennes (Montréal), QC, J3X 1P7, Canada

Abstract(300 word limit)

Luminescent nanomaterials that can be excited, as well as emit, in the near-infrared (NIR) have been investigated for use in a plethora of applications including nanomedicine, nanoelectronics, biosensing, bioimaging, photovoltaics, photocatalysis, etc. The use of NIR light for excitation mitigates some of the drawbacks associated with high-energy (UV or blue) excitation, for example, little to no background autofluorescence from the specimen under investigation as well as no incurred photodamage. Moreover, one of the biggest limitations is of course, that of penetration. As such, NIR light can penetrate tissues much better than high-energy light especially when these wavelengths lie within the three biological windows (BW-I: 700-950, BW-II: 1000-1350, BW-III: 1550-1870 nm) where tissues are optically transparent[1]. At the forefront of NIR excited nanomaterials are rare earth doped nanoparticles, which due to their 4*f* electronic energy states can undergo conventional (Stokes) luminescence and emit in the three NIR biological windows[2]. However, unlike other classes of nanoparticles, they can also undergo a multiphoton process (known as upconversion) where the NIR excitation light is converted to higher energies resulting in anti-Stokes luminescence spanning the UV-visible-NIR regions[3]. Perhaps the biggest impact of such materials would be in the field of disease diagnostics and therapeutics, now commonly referred to as theranostics[4]. Due to the versatility of their optical properties, it now becomes possible to generate high-energy light (UV or blue) *in situ* to trigger other light activated therapeutic modalities (*i.e.*, drug release) while using the NIR emission for diagnostics (*i.e.*, bioimaging, nanothermometry)[5]. Here, we present the synthesis of various NIR excited (and emitting) rare earth doped core/shell (and multishell) nanoparticles and demonstrate how their luminescence properties can be exploited for potential use in diverse biomedical applications.

Please insert Image/Figure



Recent Publications (maximum 5)

1. Hemmer, E. Benayas, A., Légaré, F., Vetrone, F., *Nanoscale Horiz.*, 1 (2016) 168-184.
2. Matulionyte, M., Skripka, A., Ramos-Guerra, A., Benayas, A., Vetrone, F., *Chem. Rev*, 123 (2023) 515-554.
3. Cheng, T., Marin, R., Skripka, A., Vetrone, F., *J. Am. Chem. Soc.*, 140 (2018) 12890-12899.
4. Liu, X., Skripka, A., Lai, Y., Jiang, C., Liu, J., Vetrone, F., Liang, J., *Nature Commun.*, 12 (2021) 6401.
5. Skripka, A., Karabanovas, V., Jarockyte, G., Marin, R., Tam, V., Cerruti, M., Rotomskis, R., Vetrone, F., *Adv. Funct. Mater.*, 29 (2019) 1807105.

Biography(150 word limit)

Fiorenzo Vetrone is currently Full Professor at INRS, Centre Énergie, Matériaux et Télécommunications, Université du Québec. Dr. Vetrone is a pioneer in the field of rare earth doped upconverting nanoparticles, publishing the first paper in the field. He has published papers in prestigious, journals such as Science, Nature Communications, Chemical Reviews, etc. that have been collectively cited more than ~18,700 times (H-index = 64). He has given more than 150 invited, keynote, and plenary lectures at prestigious conferences and seminars around the world. Moreover, he has won prestigious awards such as the Keith Laidler Award from the Canadian Society for Chemistry, the W. Lash Miller Award from the Electrochemical Society as well as the Rutherford Memorial Medal in Chemistry from the Royal Society of Canada (RSC). He was an elected member of the Global Young Academy and the College of New Scholars, Artists and Scientists of the RSC. In 2022, he was named Fellow of the Canadian Academy of Engineering.

Email: fiorenzo.vetrone@inrs.ca