Docket #: S18-147

Ultra Bright Lanthanide-Doped Nanoparticles for Luminescence Imaging

Stanford researchers have developed a lanthanide-doped upconverting nanoparticle (UCNP) that emits very photostable and non-blinking light, and is bright enough to delineate tumor boundaries to the naked eye during surgery. These UCNPs have a core-shell-shell structure with highly concentrated sensitizer Yb that increases the luminescence brightness per unit volume. Unlike conventional dyes and quantum dots, these upconverting nanoparticles do not bleach with time and non-blinking. In addition, background-free imaging could be obtained by using these probes. These brighter probes open the possibility of cellular and single-molecule tracking at low irradiance, and even greater comparative sensitivity for cell identification and tracking in live animals.

New Data: Probes have been used to perform single molecule tracking of intracellular cargo traveling on dynein motor protein.

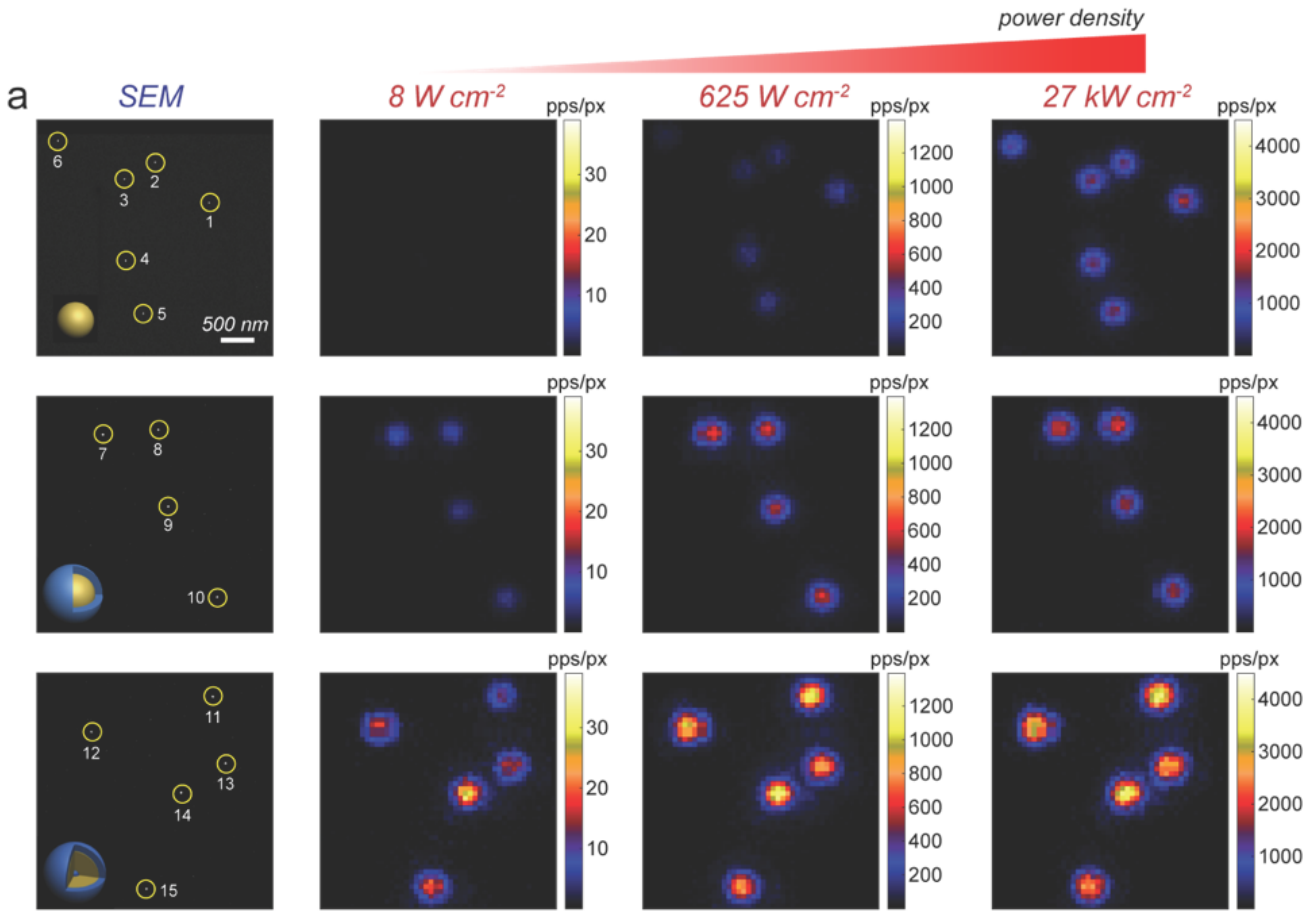

Figure 1. (a) Correlation between SEM and power density-dependent wide-field fluorescence images for three types of UCNP: (top row) 22.0 nm $NaY_{0.78}F_4:Yb_{0.2}Er_{0.02}$, (middle row) 29.1 nm $NaY_{0.78}F_4:Yb_{0.2}Er_{0.02}$@ $NaYF_4$, (bottom row) 29.4 nm $NaYF_4$@$NaYb_{0.92}F_4:Er_{0.08}$@$NaYF_4$.

Applications

- Luminescence imaging – especially for cellular imaging, and identification of tumor boundaries during surgery

Advantages

- Bright and non-blinking – bright enough to allow for direct observation of tumor boundaries during surgery
- Photobleach resistant
- Proven ability to perform single molecule tracking in cells

Publications

- Peng, Chunte Sam, et al. "Nanometer-Resolution Long-term Tracking of Single Cargos Reveals Dynein Motor Mechanisms." *bioRxiv* (2022).
- Swearer, Dayne F., et al. Single Particle Cathodoluminescence Spectroscopy with Sub-20 nm, Electron-Stable Phosphors." *ACS Photonics* (2021).
- Siefe, Chris, et al. "Sub-20 nm Core–Shell–Shell Nanoparticles for Bright Upconversion and Enhanced Förster Resonant Energy Transfer." *Journal of the American Chemical Society* 141.42 (2019): 16997-17005.
- Liu, Q. et al. Single upconversion nanoparticle imaging at sub-10 W cm?2 irradiance. *Nature Photonics.* 6 August 2018

Patents

- Issued: 11,603,492 (USA)

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