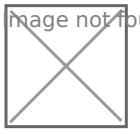
Docket #: S10-006

X-ray Molecular Imaging with Radioluminescent Nanoparticles

Researchers in Prof. Lei Xing's laboratory have developed a radioluminescent platform to combine molecular and X-ray imaging using standard X-ray equipment coupled with a photodetector. Unlike conventional all-optical molecular imaging which relies on lasers for fluorescence, this X-ray technology utilizes ionizing radiation (from either an X-ray source or a radiopharmaceutical) to stimulate light emission from on nanoparticles (such as nanophosphors). This approach enhances the signal-to-noise ratio by reducing background auto-fluorescence. It also increases depth sensitivity because the X-ray source signal has high penetration ability. The system could be integrated with a range of imaging modalities (e.g. mammography, CT, projection X-ray) to provide good spatial and anatomical resolution for pre-clinical drug discovery, real-time monitoring of radiation therapy, or cancer diagnostics.



X-ray Luminescence - *Radioluminescent nanophospors (RLNP) serve as imaging probes in vivo and can be detected by both custom X-ray luminescence and conventional small animal imaging system.*

Stage of Research

The inventors have used a small animal phantom to demonstrate the multiplexed nanophosphor platform by exciting the nanoparticles with either X-ray irradiation or radiopharmaceuticals.

Applications

- **Molecular imaging** with simultaneous X-ray imaging for:
  - medical diagnostics with disease-specific probes
  - monitoring radiation therapy in progress
  - small animal studies in pre-clinical drug discovery

Advantages

- **Disease-specific information** - radioluminescent probes can elucidate targets to improve detection over conventional X-ray imaging
- **Simple implementation** with optical detector added to any standard equipment with an x-ray source
- **Multiplexed probes** - nanoparticles can emit optical light at unique wavelengths to detect distinct molecular targets
- **Different excitation schemes** - with either X-ray irradiation (mammography, CT, fluoroscopy, projection X-ray, radiotherapy) or radiopharmaceuticals (brachytherapy seed, PET or SPECT radioisotope)
- **Advantages of radioluminscence over all-optical molecular imaging:**
  - reduced background auto-fluorescence because no optical source (such as a laser) is used
  - increased depth sensitivity due to the penetration abilities of X-rays
  - simultaneous x-ray and optical molecular imaging for good spatial and anatomical resolution

Publications

- Carpenter C, Pratx G, Sun C, Liu S., Cheng Z,Xing L,, Radioluminescent Nanophosphors Enable Multiplexed Small-Animal Imaging, *Optics Express* 20, 11598-604, 2012
- Sun C, Pratx G, Carpenter CM, Liu H, Cheng Z, Gambhir SS, and Xing L, Synthesis and Radioluminescence of PEGylated Eu3+-doped Nanophosphors as Bioimaging Probes, *Advanced Materials* 23, H195-9, 2011.

Patents

- Published Application: 20110251484

Innovators

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