Background and Motivation

- The neutralization of biological agents via explosions requires temperature measurements of inside the fireball of an explosion, which is currently unavailable.
- Luminescent nanoparticles (LNs), which are seeded into an explosion, are developed to monitor the temperature through optical properties that change with heat and time.
- Reference measurements of the optical properties of these materials are performed in the lab and in turn compared to samples that have been subject to explosive heating.
- The development of these temperature sensors requires screening a large number of materials which requires a non-laser-based fluorescence spectroscopy setup.

Objective

- Design, build, and test a non-laser-based fluorescence spectroscopy setup capable of measuring the fluorescence and excitation spectra of small amounts of sensor materials.

Experiments

- Excitation by small range of tunable wavelengths into selected energy levels of rare-earth ions.
- Excitation via UV light into charge-transfer band of host materials.
- Measure wavelength-dependent fluorescence intensities.

Spectrofluorometer Schematic

- Halogen lamp excitation method
  - 150 W, collimated incandescent light is focused into a monochromator (2.38 nm/mm linear dispersion).
  - Tunable wavelengths exit the monochromator and focus on the sample via a system of optical lenses.

Comparison of Eu²⁺:Y₂O₃, Tb³⁺:Y₂O₃ and Eu³⁺:ZrO₂

- Different emission peaks based on the RE dopant, core shell and calcination process.
- Sharper emission peaks from calcined samples.

Conclusions

- Between the two excitation methods, the system can efficiently excite RE doped oxides with a wide range of tunable wavelengths.
- The system can quickly collect fluorescence emission data.
- The more calcined the oxide, the sharper the fluorescence emission spectrum.