RADIOLUMINESCENCE OF Y_2O_3:Eu NANOCRYSTALS

Nick Guggemos, Cory Cress, Ryne Raffaelle, Physics, ngg6097@rit.edu, rprsps@rit.edu*

Abstract:

Radioisotope batteries utilize a p-n junction to convert the kinetic energy of alpha or beta particles into electricity. Alternatively, for long-life batteries, an intermediate absorber layer can be used to convert the particle's kinetic energy into photons which are then converted into electricity.

Europium doped Yttrium Oxide (Y_2O_3:Eu^{3+}) is a prominent red emitting phosphor which has been widely utilized in thin film displays and cathodoluminescent devices. It is well known for having high photo- and cathodoluminescent efficiencies, and with a peak emission wavelength at approximately 610nm it is a prime candidate for use as an intermediate absorber in radioisotope batteries with wide band-gap photovoltaic cells.

The radioluminescent efficiency and radiation tolerance of Y_2O_3:Eu^{3+} nanocrystals was determined from the measurement of their radioluminescence under a known fluence of alpha particles. Nanocrystals of Y_2O_3:Eu^{3+} were synthesized by the Urea precipitation method and the size of the nanocrystals was varied by the addition of EDTA. The effect of particle size and Eu^{3+} concentration on radioluminescent efficiency and radiation tolerance were determined. The development of an effective intermediate absorber will make it possible to develop radioisotope batteries with a lifetime measured in decades or centuries.