RARE-EARTH DOPED PHOSPHORS FOR RADIOISOTOPE BATTERIES.

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Energy density is the prime concern for batteries, especially in the case of micro batteries. The highest potential energy given for such batteries is of course from radioisotopes. One particular type of radioisotope battery is the indirect drive battery. One type of indirect drive radioisotope battery uses radiation from a radioisotope source to excite a phosphor layer to produce photons. The production of photons from incident radiation is called radioluminesence (RL). These photons can then be converted into useable electricity by a semiconductor photodiode next to the phosphor layer. The key characteristics of the phosphor layer for a successful device include the RL efficiency and radiation tolerance. A series of nano-crystalline yttrium oxide phosphors doped with rare earth ions (Tb^{3+}, Eu^{3+}) were synthesized using the UREA precipitation technique. These phosphors are an appropriate choice because the energies they emit at are well matched with the absorption of InGaP photodiodes, which are currently under development in the NPRL. Thin films of varying thickness were prepared by spraying synthesized phosphors suspended in acetone onto glass slides. The thickness is measured via profilometery and the optimal thickness is determined from plots of RL versus thickness. Using this optimal thickness for all subsequent measurements, the RL intensity was studied as a function of varying dopant, concentration of dopant, and particle size. Finally, we will present the I-V characteristics of a prototype radioisotope battery, comprised of yttrium oxide, an InGaP diode and an americium α particle source for the most promising phosphor.