Contribution ID: **15** Type: **Oral Presentation**

A scheme to analyze the decay time of rare earth ions using a square wave technique

Wednesday, 27 June 2018 15:40 (20 minutes)

Three samples La2O3:Er3+/Yb3+ (LEY), La2O3:Ho3+/Yb3+ (LHY) and La2O3:Er3+ (LE) were synthesized via the combustion method. Urea was used as a fuel and reducing agent. The samples were annealed at 800 oC for 4 hours in order to get good crystallization. The phase confirmation of the samples was carried out by using X-ray diffraction analysis. Surface morphology of the sample was done by field emission scanning electron microscopy analysis with spherical particles. Fourier transformed infra-red transmittance of the samples was done in order to investigate the impurities. The annealed samples (800 oC) were further used for optical measurements. Upconversion emission of all the samples were measured and three prominent bands were monitored at 522, 548 and 662 nm corresponding to 2H11/2 → 4I15/2, 4S3/2 → 4I15/2 and 4F9/2 → 4I15/2, manifolds, respectively. The decay time measurements were done using a monochromator coupled with a Cathode ray oscilloscope (CRO). A continuous laser beam (976 nm) was chopped using a mechanical chopper (1000 Hz). Thus the data acquired by using the CRO was plotted as a square wave and this wave was further used to analyze the decay time with fixing different fitting parameters. This technique of decay time measurements is very inexpensive and easy handled. Thus the calculated decay time of the samples were found to be 252 ms, 102 ms and 54 ms, for LEY, LHY and LE, respectively.

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Session Classification: Applied Physics

Track Classification: Track F - Applied Physics