Luminescence Studies of $BaSiO_3:Eu^{2+}$, Ln(Ln = Pr^{3+}, Yb^{3+}) Materials for Silicon Solar Cell Application.

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Light is a form of energy and an important aspect in physics which helps mankind appreciate the usefulness of nature. The method at which solar energy is harnessed and utilized has become an important aspect of research area in recent years. It is widely utilized in the form of solar cells. The silicon (Si) solar cells are always available in commercial market because of the low cost and abundance in nature, but the efficiency of the Si solar cells is generally limited to about 30 %. This can be attributed to the spectra mismatch between solar distribution and spectra response of the silicon-based solar cells. The low energy photons cannot be efficiently absorbed, while the absorption of the high energy photons is usually accompanied by rapid relaxation of hot electron-hole pairs to the band edges of the solar cell, due to thermalization. The spectra modification is a useful method to improve the efficiency of the Si solar cells. In this work, down conversion (DC) spectra modification was demonstrated via the luminescence studies of $BaSiO_3:Eu^{2+}$, Ln (Ln = Pr^{3+}, Yb^{3+}) materials, to reduce the spectral mismatch losses of the Si solar cells. A thin layer of the DC material is placed on top of the Si solar cell to optimize the impinging photon. It was identified that the Si solar cells effectively convert energy photons close to the Si solar cell band gap, but the solar spectrum striking the solar cells dominates within the UV-vis region. However, we established that if the UV-vis photons can be converted into NIR photons before absorption into the Si solar cells as presented in **Fig. I** and **Fig. II**, the thermal losses of the Si solar cell could be reduced and the power performance of the Si solar cells could be enhanced.

Fig. I: Overlap between the excitation spectrum of Pr^{3+} observed at 618 nm wavelength and the emission spectrum of Eu^{2+} at 501 nm wavelength.

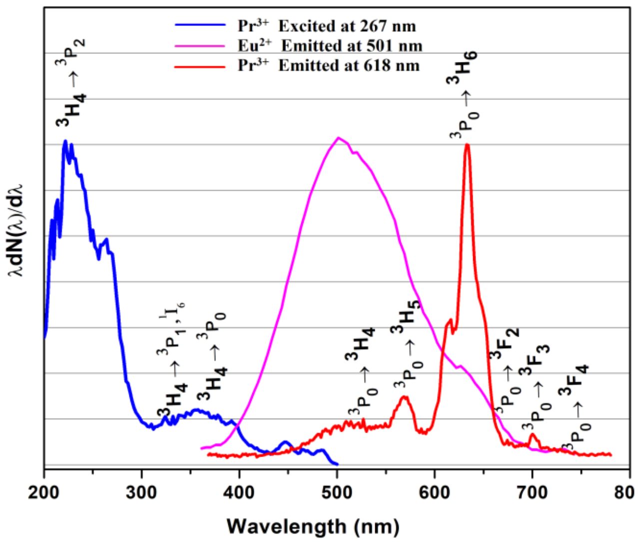

Fig. II: Overlap between the excitation spectrum of Yb^{3+} observed at 976 nm wavelength and the emission spectrum of Eu^{2+} at 501 nm wavelength.