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Co-doped Yb3+/Pr3+ fluorindate glass for enhanced silicon solar cell performance by down-conversion of high-energy photons

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Fluoroindate glasses co-doped with Yb3+/RE such as Pr3+, are promising materials to enhance photovoltaic devices (PV) efficiency fabricated with silicon that have a low energy conversion efficiency when converting solar energy to electricity. The PV conversion efficiency which has a maximum of spectral response at 1000 nm (1.12eV) can be greatly enhanced using the Ytterbium emission at 980 nm, closer to the Si bandgap energy. Using a sensitizer ion as Pr3+ as co-doping ion, it is possible to increase the near-infrared efficiency emission of Yb3+ ion through cooperative down-conversion mechanisms, where one incident photon with high energy is absorbed by the sensitizer ion, emitting two other photons with lower energy. Thus, the PV conversion efficiency can be enhanced. In this work, the Yb3+ ion was used as luminescent center co-doped with Pr3+ as ion sensitizer, embedded into a fluoroindate glass (40InF3-20BaF2-20SrF2-20ZnF2) to study the cooperative down-conversion process from Pr3+ to Yb3+ through photoluminescence measurements. Near-infrared quantum cutting regarding the Yb3+ emission (960 to 1040 nm) was collected upon the excitation of Pr3+ ion using an excitation source at 480 nm. The efficiency of 980 nm emission from fluoroindate glasses co-doped with Yb3+/Pr3+ shows the potential of the material as a candidate for application as down-conversion layer on the surface of silicon solar cell panels in order to improve the PV conversion efficiency.