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Graphical abstract

A narrow band-gap NiS semiconductor like “conductive ladder” is inserted between $\text{Er}^{3+}:\text{Y}_3\text{Al}_5\text{O}_{12}@\text{NiGa}_2\text{O}_4$ and $\text{Bi}_2\text{Sn}_2\text{O}_7$ to accelerate the electron transfer from conduction band of $\text{Bi}_2\text{Sn}_2\text{O}_7$ to valence band of NiGa_2O_4 . $\text{Er}^{3+}:\text{Y}_3\text{Al}_5\text{O}_{12}$ as an up-conversion luminescence agent (from visible-light to ultraviolet-light) provides enough ultraviolet-light for satisfying the energy demand of wide band-gap NiGa_2O_4 . The prepared Z-scheme

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