Coexistence of Ferromagnetism and Enhanced Photo-response in Fe-Doped $SnSe_2$ Single Crystals

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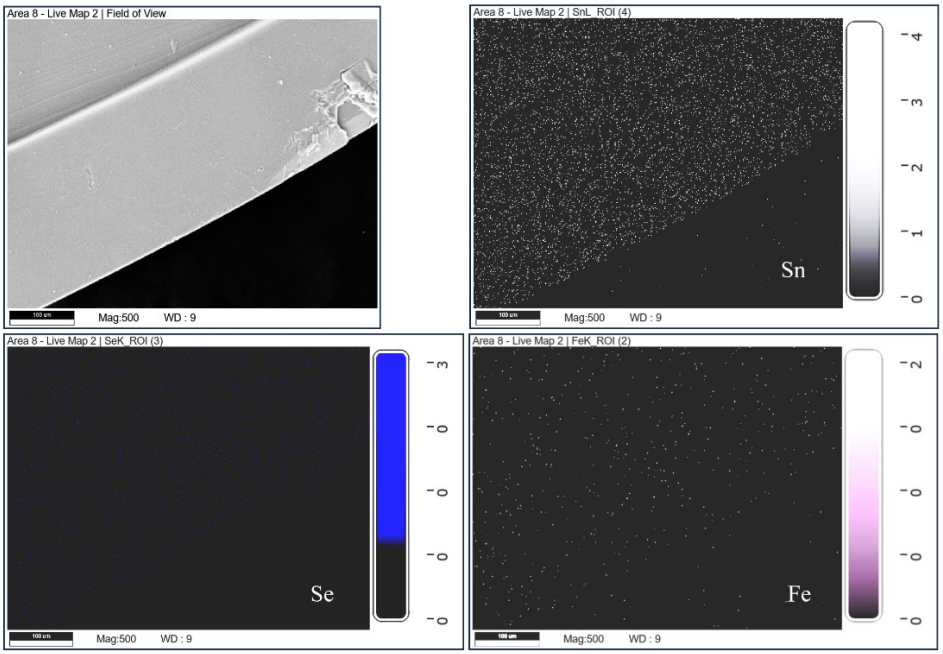
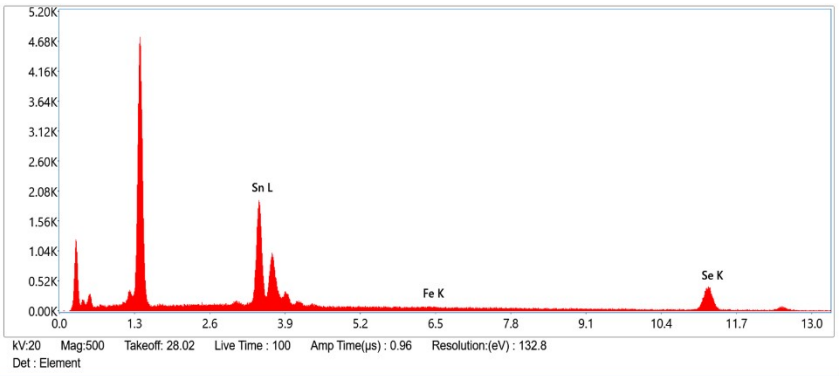
Supplementary Information

S1. Energy dispersive X-ray spectroscopy (EDS) result of Fe-doped $SnSe_2$: For each synthesized crystal EDS measurement is performed on two to three different spot to confirm homogenous distribution of Fe in the crystal.

(a) Elemental-mapping of Sn, Se, Fe and EDS spectra of 1 % Fe-doped $SnSe_2$.

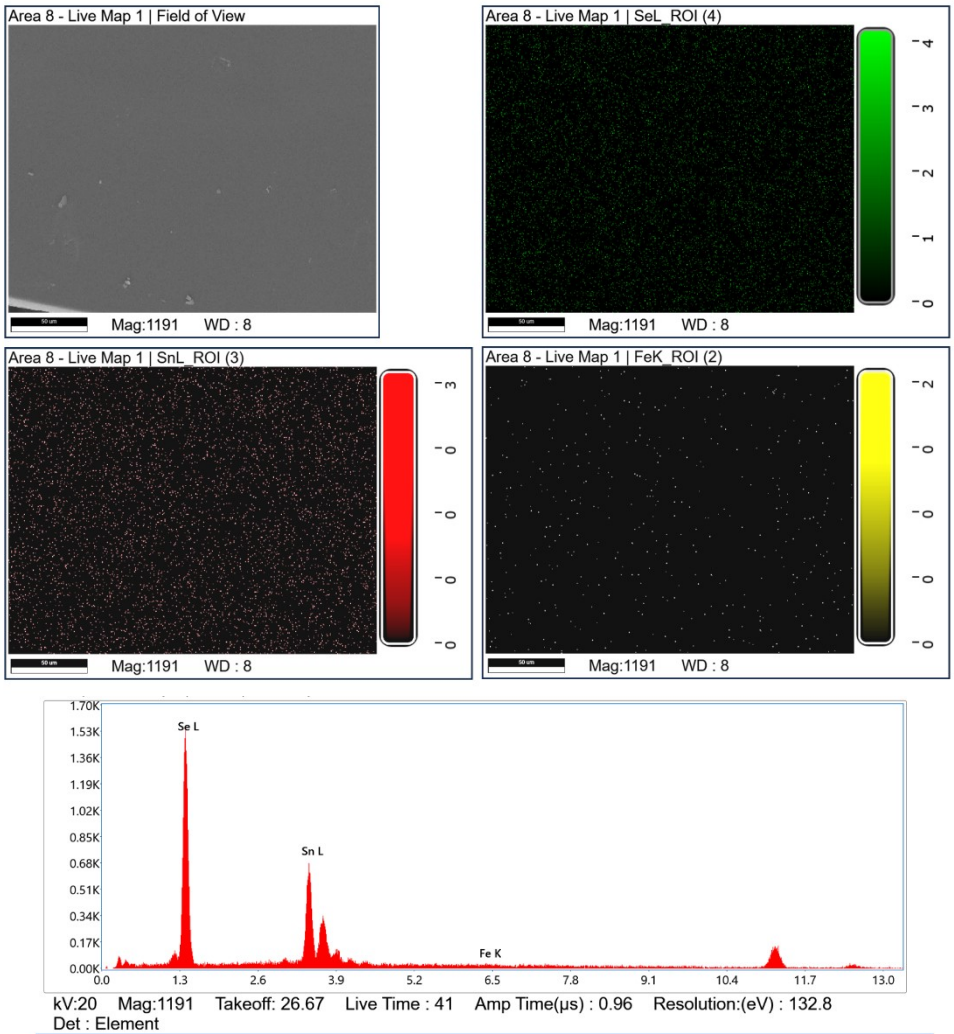




eZAF Quant Result - Analysis Uncertainty: 7.23 %								
Element	Weight %	MDL	Atomic %	Error %	Net Int.	R	A	F
Fe K	0.5	0.65	0.8	57.8	3.5	0.8419	0.8713	1.0978
Se K	59.2	2.39	68.3	5.6	76.0	0.9206	0.9749	1.1210
Sn L	40.3	0.74	30.9	5.8	199.6	0.8045	0.7252	1.0065

(b) Elemental-

mapping of Sn, Se, Fe and EDS spectra of 3% Fe-doped $SnSe_2$.



cZAF Quant Result -Analysis Uncertainty: 9.69 %								
Element	Weight %	MDL	Atomic %	Error %	Net Int.	R	A	F
Fe K	1.5	2.15	2.5	54.3	3.2	0.8703	0.9167	1.0784
Se L	54.6	2.45	63.5	7.8	194.1	0.7676	0.4446	1.0018
Sn L	43.9	1.42	34.0	7.9	90.2	0.8187	0.8164	1.0056

Fig. S1. The EDS mapping and spectra (a) for 1% Fe-doped and (b) for 3% Fe-doped $SnSe_2$ single crystals.

S2. Absorbance spectra of $SnSe_2$ and doped systems: The absorbance spectra were recorded for polycrystalline samples of $SnSe_2$ and Fe-doped $SnSe_2$. Due to the limited availability and flake-like morphology of the single crystals, absorbance measurements could not be performed on single-crystal specimens. It is evident that with Fe-doping band gap decreases.

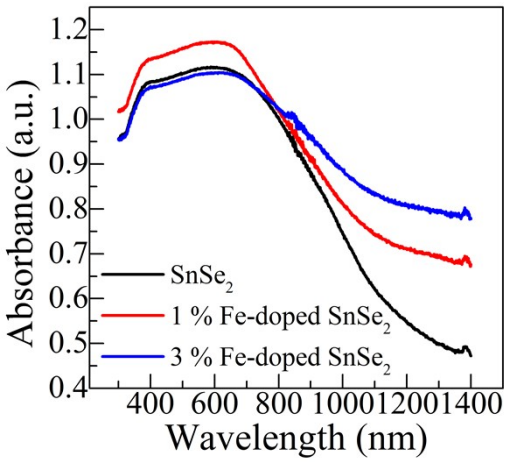


Fig. S2. Absorbance spectra of undoped and Fe-doped $SnSe_2$ polycrystalline samples.

S3. Tauc plots for indirect transitions: The diffuse reflectance spectrum of $SnSe_2$ and Fe-doped $SnSe_2$ is measured by diffuse reflectance spectroscopy. The raw spectra were transformed to absorption spectrum $(Fh\nu)^{1/2}$ by applying the kubelka-munk function. The calculated band gap decreases with Fe-doping hence it is confirmed that Fe-doping increases the valence band maxima and decreases the conduction band minimum.

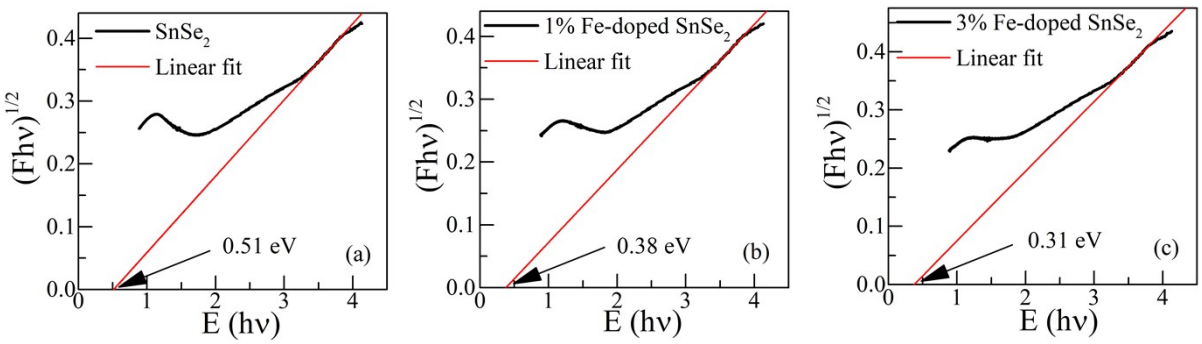


Fig. S3. Tauc plot of undoped and doped $SnSe_2$ samples. The linear part of the plot is extrapolated to the x-axis. The value of the absorption spectrum $(Fh\nu)^{1/2}$ was transformed from the raw diffuse reflectance spectrum by applying the kubelka-munk function.