Supplementary Information

Defect-induced room temperature ferromagnetism in Cu-doped In$_2$S$_3$ QDs

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Table S1 Summary of some structural parameters of 2-theta, lattice parameter (a), FWHM, average crystallite size, dislocation density and micro strain for Cu-doped In_2S_3 QDs with different doping concentrations.

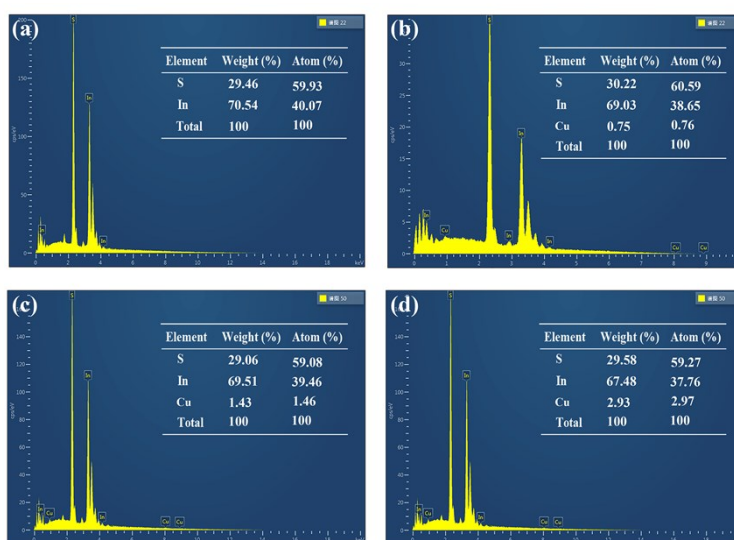| Sample	$(2\theta)_{22\,12}$	c(nm)	$FWHM_{(22\,12)}$	$D(nm)_{22\,12}$	$\delta\ (\times 10^{-3})$	$\varepsilon\ (\times 10^{-3})$
pristine In_2S_3	48.20	3.202	3.21	2.68	373	31.31
0.5% Cu	48.22	3.201	3.15	2.73	366	30.71
1.5% Cu	48.25	3.199	3.04	2.83	353	29.62
2% Cu	48.27	3.198	3.09	2.79	358	30.09

Fig. S1 EDX patterns of pristine In_2S_3 (a) and Cu-doped In_2S_3 QDs with dopant concentration of 0.5% (b), 1.5% (c), 2% (d).
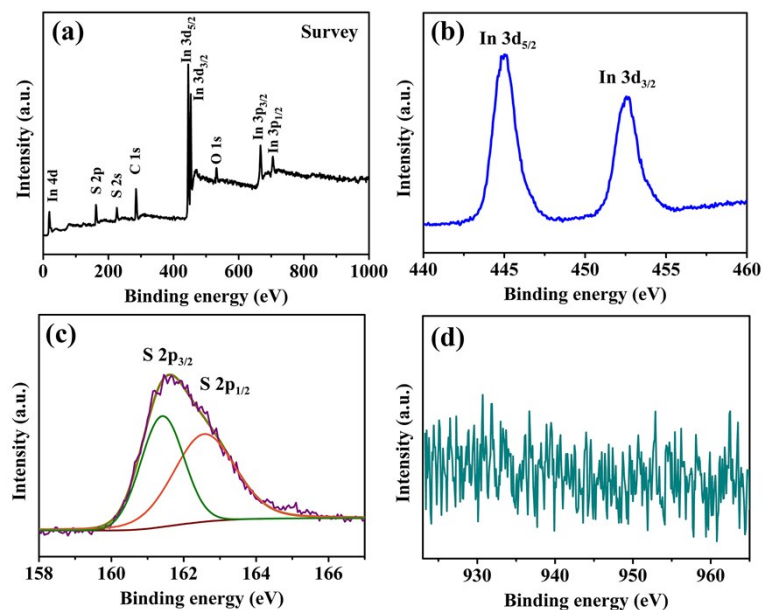
Fig. S2 (a) XPS survey spectrum and high resolution XPS spectra of the pristine In_2S_3 QDs corresponding to (b) In 3d, (c) S 2p, (d) Cu 2p regions.
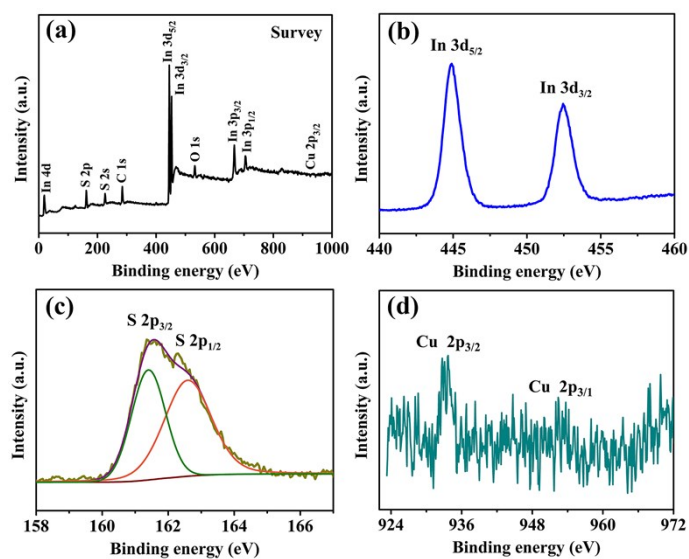

Fig. S3 (a) XPS survey spectrum and high resolution XPS spectra of Cu (0.5 %) doped In_2S_3 QDs corresponding to (b) In 3d, (c) S 2p, (d) Cu 2p regions.
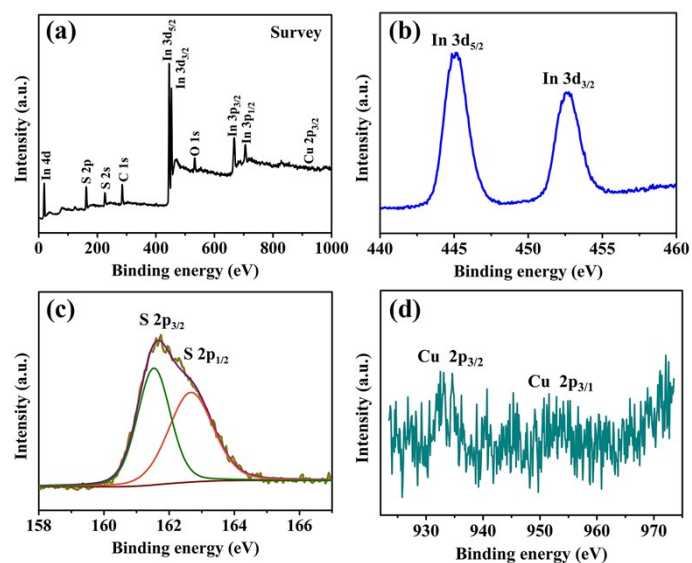
Fig. S4 (a) XPS survey spectrum and high resolution XPS spectra of Cu (1.5 %) doped In_2S_3 QDs corresponding to (b) In 3d, (c) S 2p, (d) Cu 2p regions.
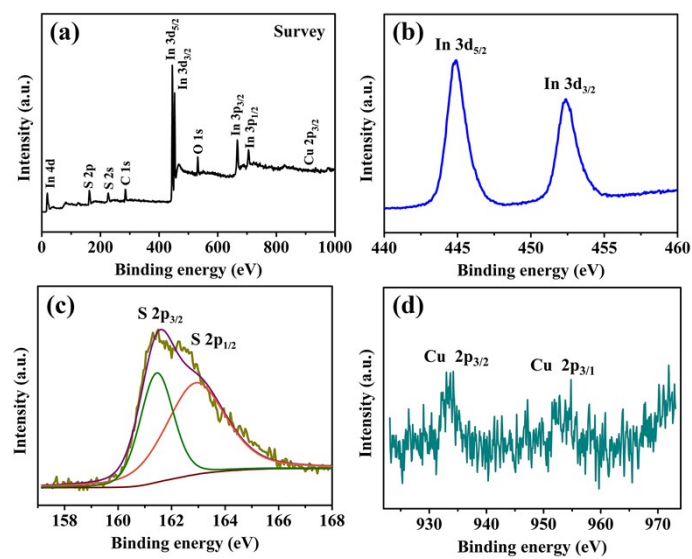

Fig. S5 (a) XPS survey spectrum and high resolution XPS spectra of Cu (2 %) doped In_2S_3 QDs corresponding to (b) In 3d, (c) S 2p, (d) Cu 2p regions.
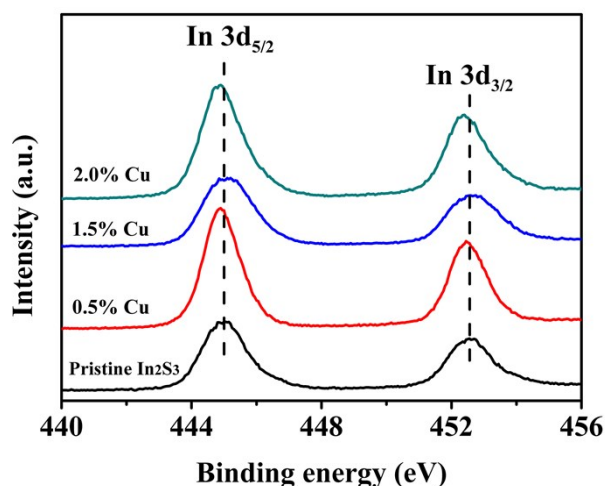
Fig. S6 In 3d core levels measured from the pristine In_2S_3 and Cu-doped In_2S_3 QDs. From the XPS survey spectrum of the all sample, the Cu-doped In_2S_3 spectrum consists of In, S, O and Cu elements except for the C 1s peak, and no impurities and magnetic contamination are detected, indicating the high purity of Cu-doped In_2S_3 QDs. The O 1s peak recorded on the sample may be due to absorbed O_2, H_2O and CO_2 on the surface of the material. The In 3d spectrum (Fig. S2b) shows two peaks at 444.9 eV and 452.7 eV, corresponding to the binding energy of In $3d_{5/2}$ and In $3d_{3/2}$ for In^{3+} ions, respectively. In the S 2p spectrum (Fig. S2c), two peaks with binding energies at 161.4 eV and 162.6 eV are assigned to S $2p_{3/2}$ and S $2p_{1/2}$, respectively, indicating the existing of S^{2-} in In_2S_3.
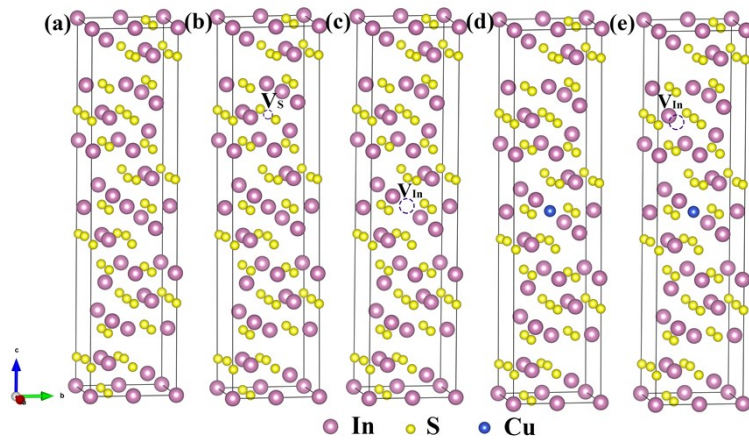
Fig. S7 Five calculation models: (a) the ideal system with no defects or dopants ($In_{32}S_{48}$), (b) one S vacancy system (V_S), (c) one In vacancy system (V_{In}), (d) one Cu atom doped system (Cu_{In}), (e) one In vacancy and one Cu atom doped system ($Cu_{In}+V_{In}$).