Supplementary Information - Hydrogen-induced conversion of SnS_2 into SnS or Sn: a route to create SnS_2/SnS Heterostructures

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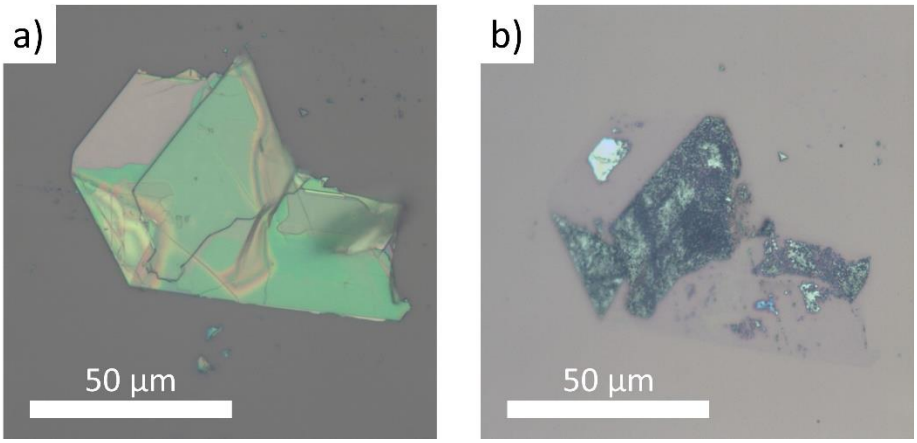

Figure S 1: Optical images of a) SnS2 flake on an SiO2 substrate, b) the same fake after exposure to H2 at 6x10-3 mbar for 7 hours at 250 Celsius.

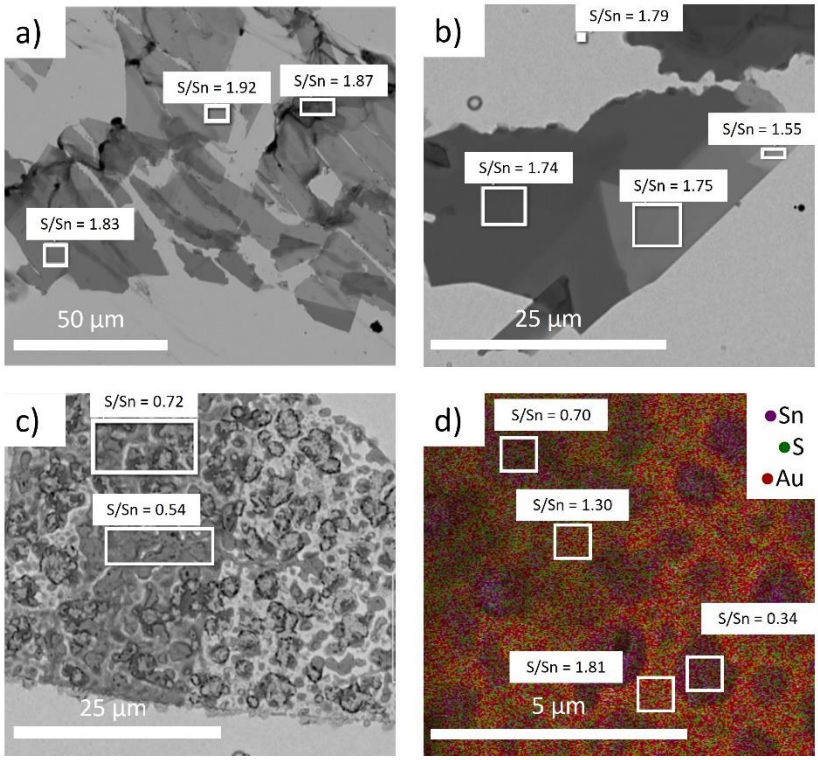

Figure S 2: SEM images of SnS_2 flakes on a gold substrate: a) control Sample, b) sample exposed to H_2 at $7x10^{-4}$ mbar for 7.5 hours at 150 Celsius, c) sample exposed to H^+ from a Kaufman ion source with a beam energy of 8 eV for 1.2 hours at 150 Celsius. d) an EDX map of the proton exposed sample.

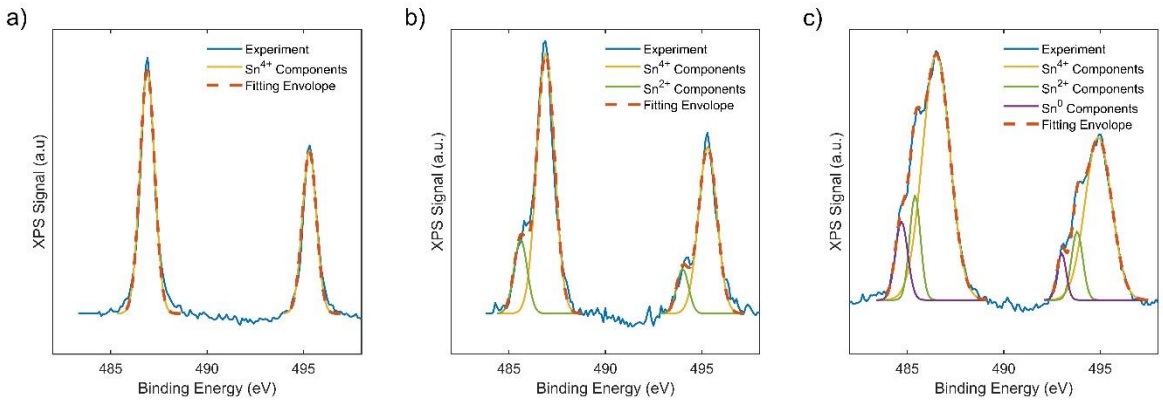

Figure S 3: XPS spectra showing the Sn^x components of the: a) control sample, b) H_2 exposed sample at $7x10^{-4}$ mbar for 7.5 hours at 150 Celsius, and c) the H^+ exposed sample with a beam energy of 8 eV for 1.2 hours at 150 Celsius.

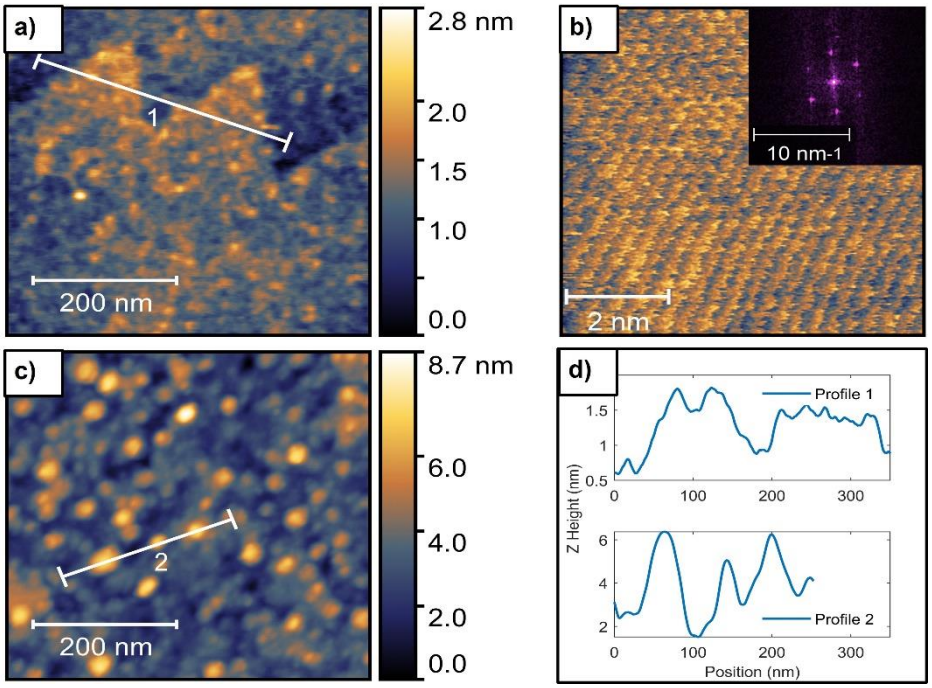

Figure S 4: AFM maps of a&b) the control sample of SnS_2 on a gold substrate (inset) the reciprocal space image of b). c) The AFM map of SnS_2 exposed to H_2 at $7x10^{-4}$ mbar for 7.5 hours at 150 Celsius. d) Height profiles corresponding to the line is a) and c).

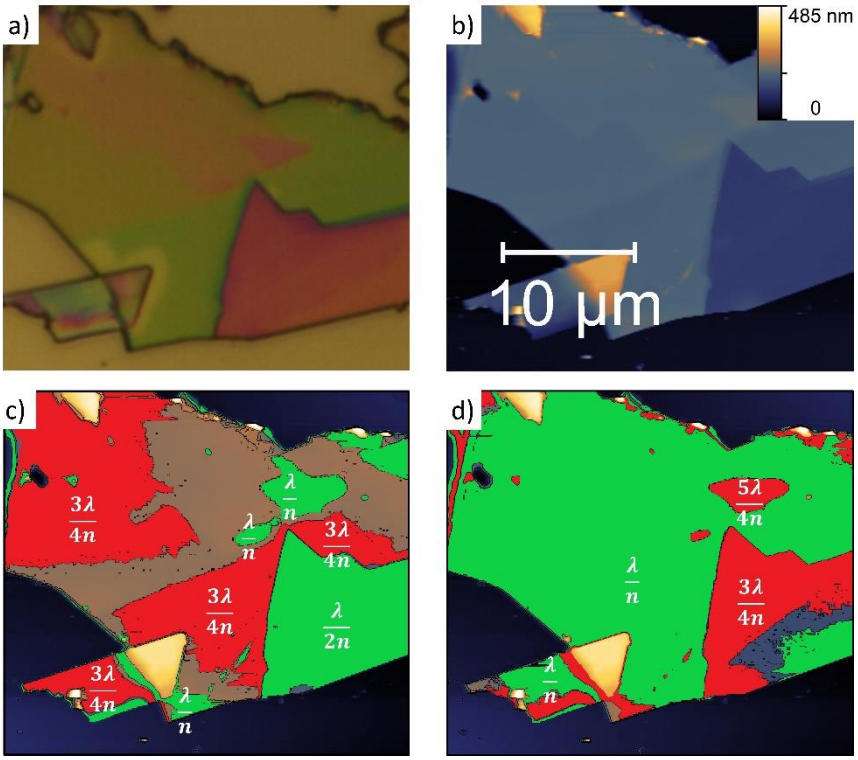

Figure S 5: a) Optical image of an SnS_2 fake exposed to H_2 at $7x10^{-4}$ mbar for 7.5 hours at 150 Celsius. b) AFM height map of the flake in a). c) AFM map as in b) indicating regions in which the constructive (green) and destructive (red) optical interference conditions are met for λ = 632.8 nm. d) AFM map in b) indicating regions in which the constructive (green) and destructive (red) conditions are met for λ = 532.0 nm. Here, n=2.8 is the refractive index of SnS_2.

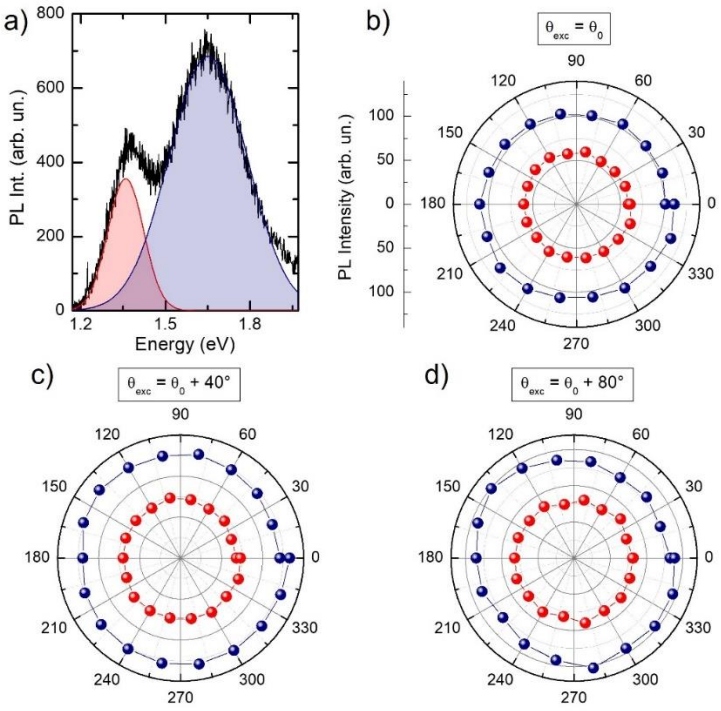

Figure S 6: a) PL spectrum from SnS/SnS_2 heterostructure with individual PL components indicated in red and blue. Polarisation maps recorded with the polarised excitation angle (θ_{exc}) relative to the arbitrary direction (θ_0) for: a) $\theta_{exc} = \theta_0 + 0^{\circ}$, b) $\theta_{exc} = \theta_0 + 40^{\circ}$ and c) $\theta_{exc} = \theta_0 + 80^{\circ}$. Red and blue polarisation plots correspond to the matching components in a).

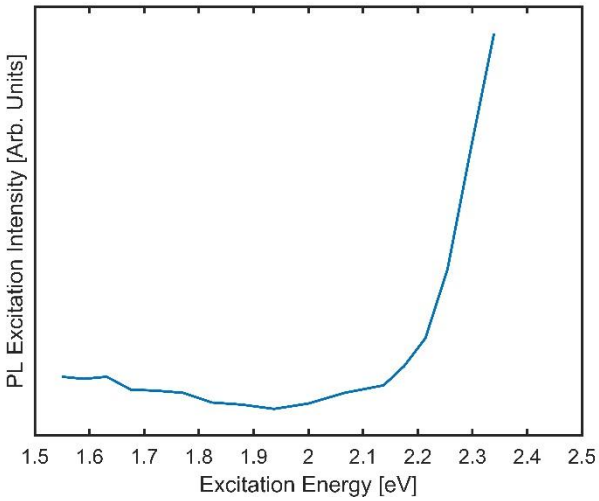

Figure S 7: Photoluminescence excitation (PLE) spectrum for a SnS/SnS_2 heterostructure. The experiment is conducted at room temperature with a detection energy of *hv* = 1.4 eV, corresponding to the low-energy PL peak of the PL spectrum shown in Figure S 6 a)