Supporting Information

Fast and robust infiltration of functional material inside titania nanotube layers: case example for a chalcogenide glass sensitizer

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Synthesis of As3S7

Synthesis of As3S7 was performed according to the previously published literature, see e.g. Refs. 34, 36. In brief, the chalcogenide glass was prepared in two steps: 1) by mixing 5N elements of appropriate weights in evacuated quartz ampoules placed in rocking furnace, and 2) following quenching the melt to room temperature.

Photoelectrochemical experiments

The photoelectrochemical setup consisted of a SP-300 BioLogic potentiostat and a three-electrode cell using a platinum counter electrode and a Ag/AgCl reference electrode. The photoelectrodes were pressed against an O-ring of the cell leaving an irradiated area of 0.5 cm2. The electrodes were irradiated from the frontside, i.e. through a quartz window and a Na2SO4 (0.1 M) + KI (0.1 m) electrolyte. Monochromatic wavelength-resolved measurements of incident photon-to-current efficiencies (IPCE) were preformed using a tunable monochromatic light source (Instytut Fotonowy, www.fotonowy.pl) provided with a 150 W Xenon lamp and a grating monochromator with a bandwidth of ~10 nm. The monochromatic intensities between 330 nm and 800 nm were in the range of 0.6 – 4.3 mW/cm2. Appropriate cut-off filters were used in order to eliminate second-order diffraction radiation. The value of photocurrent density was taken as a difference between current density under irradiation and in the dark. The IPCE value for each wavelength was calculated according to equation IPCE (%) = (i_phhc)/(λPq) × 100, where i_ph is the photocurrent density, h is Planck’s constant, c velocity of light, P the light power density, λ is the irradiation wavelength, and q is the elementary charge. The spectral dependence of lamp power density was measured by the NOVA II optical power meter equipped with a PD300-UV silicon photodiode (Ophir Optronics).
UV-Vis absorption spectra

The UV-Vis electronic absorption spectrum of a spin-coated layer of As$_3$S$_7$ on an ITO glass was measured on using a Perkin Elmer Lambda 650 UV–Vis spectrophotometer in transmission mode.

Figure S1: Electronic absorption spectrum of As$_3$S$_7$ thin film (thickness approx. 100 nm) on ITO-glass. The inset shows bandgap determination using the Tauc formalism and assuming an non-direct optical transition. The weak sub-bandgap absorption (so called Urbach tail) is probably due to surface and bulk defects in amorphous As$_3$S$_7$.

Figure S2: Photocurrent response of As$_3$S$_7$ thin film on ITO-glass recorded under intermittent monochromatic irradiation ($\lambda = 430$ nm) in Na$_2$SO$_4$ (0.1 M) electrolyte (scan rate = 5 mV/s).
**Figure S3:** Photocurrent response of TiO$_2$ nanotubes infiltrated by As$_3$S$_7$ (0.1 g/ml) recorded in a Na$_2$SO$_4$ (0.1 M) + KI (0.1 M) electrolyte under intermittent monochromatic irradiation at 330 nm (a) and 480 nm (b); scan rate = 5 mV/s.

**Figure S4** Example of EDX spectra of the As$_3$S$_7$ infilled nanotubes confirming clearly the presence of As, S species next to Ti and O species.