Supplementary Information

Synthesis of Monodispersed AgBiS₂ Quantum Dots with a Giant Dielectric Constant

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Experimental

Synthesis and purification of AgBiS₂ QDs with narrow size distribution

Reagent powders were carefully weighted with an uncertainty of ± 0.1 mg using a balance (Mettler Toledo ML104). Reactions were performed in a glass manifold under purified argon atmosphere. In a typical synthesis, AgNO₃ (0.5 mmol), oleylamine (OLA, 20 ml), and a Teflon-coated stir bar were loaded into a 50-mL three-neck flask. The flask was fixed in a magnetic heating mantle, equipped with a thermocouple and a PID temperature controller through a neck of the flask to control the solution temperature. The flask was purged off air and water by argon through another neck and a condenser tube was settled in the third neck as the gas outlet. After purging off air and water, precursor solution was heated to 180 °C and maintained at this temperature for 30 min under stirring. Then temperature was decreased to 120 °C when 0.5 mmol Bi(NO₃)₃ was added to the reaction flask. After 30 min, temperature was increased to 180 °C when 1.5 mmol S was finally added. The reaction took place at 180 °C for 3 h under stirring and Ar bubbling. After reaction, AgBiS₂ nanocrystals were precipitated by adding ethanol into the flask, and purified by repeatedly ethanol washing and centrifuging. For transmission electron microscopy (TEM) characterization, AgBiS₂ QDs were washed by ethanol 1-3 times and dispersed in tetrafluoroethylene. Several drops were applied on TEM grids. Powder of AgBiS₂ QDs was obtained by adding ethanol into the supernatant, centrifuging, and vacuum drying of the precipitate. For dielectric test, powder was pressed into pellets under pressure of 40 MPa and duration of 10 min. The size of the pellet is radius of 9.525 mm (area 285 mm²) and thickness of 1 mm.

Characterization

The size and morphology of the $AgBiS_2$ QDs were studied by TEM and high-resolution TEM (HRTEM, JEM-2010). The stoichiometry was analyzed by an Oxford INCA energy dispersive

spectrometer (EDS) equipped on TEM. The crystallinity was characterized by powder X-ray diffraction (XRD, Philips X'pert Pro). Optical absorption spectra were obtained using a UV-vis-NIR spectrometer (Shimadzu SolidSpec-3700) with an integral sphere detector. X-ray photoelectron spectroscopy (XPS) analysis was performed applying the spectrometer of Thermo-VG Scientific ESCALAB 250. Pellet of AgBiS₂QDs was connected with copper wire on each side by silver paste for electrical tests. Dielectric constant was tested on an analyzer of LCR HiTESTER 3532-50 (Hioki). Impedance analysis was conducted on an electrochemical workstation (Zahner IM6ex).



Fig. S1 Statistic analysis of the size distribution of AgBiS₂ QDs. The curve fitting is for normal distribution.



Fig. S2 TEM images, SAED pattern, and EDS of AgBiS₂ nanorods.



Fig. S3 XRD patterns of the products synthesized under different experimental conditions.



Fig. S4 *I-V* curve of AgBiS₂ QD pellet under dark.



Whithout any Bias Voltage Given Negative Bias Voltage Given Positive Bias Voltage

Fig. S5 Band structure of AgBiS₂ QD pellet under different bias conditions.



Fig. S6 Electric analog for EIS curve fitting.