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# Boron quantum dots all-optical modulator based on efficient photothermal effect

Cong Wang<sup>1†</sup>, Qianyuan Chen<sup>2†</sup>, Hualong Chen<sup>1</sup>, Jun Liu<sup>1</sup>, Yufeng Song<sup>1</sup>, Jie Liu<sup>3</sup>, Delong Li<sup>1</sup>, Yanqi Ge<sup>1</sup>, Youning Gong<sup>1\*</sup>, Yupeng Zhang<sup>1\*</sup> and Han Zhang<sup>1</sup>

<sup>1</sup>Collaborative Innovation Center for Optoelectronic Science & Technology, International Collaborative Laboratory of 2D Materials for Optoelectronics Science and Technology of Ministry of Education, Institute of Microscale Optoelectronics, Shenzhen University, Shenzhen 518060, China; <sup>2</sup>School of Physics and Technology, and MOE Key Laboratory of Artificial Micro-and Nano-Structures, Wuhan University, Wuhan 430072, China; <sup>3</sup>Shandong Provincial Engineering and Technical Center of Light Manipulation & Shandong Provincial Key Laboratory of Optics and Photonic Device, School of Physics and Electronics, Shandong Normal University, Jinan 250014, China. <sup>†</sup>These authors contributed equally to this work.

'Correspondence: YN Gong, E-mail: youninggong@szu.edu.cn; YP Zhang, E-mail: ypzhang@szu.edu.cn

#### This file includes:

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# Section 1: Preparation of BQDs

In a typical procedure, 25 mg bulk boron powder was directly added into 50 ml dimethylformamide (DMF) solvent to form a suspension with the initial concentration of 0.5 mg/ml. The suspension was firstly sonicated by 700 W probe ultrasonication for 3 h at 5 °C, then centrifuged at 6000 rpm for 30 min to remove unexfoliated boron particles. Next, the obtained light brown dispersions in DMF were centrifuged at 15000 rpm for 1 h to concentrate the as-exfoliated boron sample. After that, the collected boron samples were further treated by high energy ball milling (Nanjing University Instrument Plant, QM-3SP2) with a rate of 500 rpm for 24 h. Finally, the resultant boron/DMF solution was centrifuged successively at 10000 rpm for 30 min and 13000 rpm for 60 min to obtain the final BQDs product.

#### Section 2: Determination of the absorption coefficient of BQDs dispersions

Typically, the as-prepared BQDs dispersion was further centrifuged at 15000 rpm for 1 h. The resultant solid product was collected, followed by drying under vacuum at 60 °C for 8 h. 3.5 mg of the solid BQDs product was then redispersed in 4 mL of deionized water (DIW) by 15 min sonication under a constant temperature of 10 °C. The obtained BQDs/DIW dispersion was used to determine the corresponding absorption spectra.

#### Section 3: Characterization

The morphology and microstructure of the samples were characterized via scanning electron microscope (SEM; Sirion, FEI, Netherlands), HRTEM (Tecnai G2 F30) and AFM (Dimension Edge, Bruker, America) equipped with an energydispersive X-ray spectrometer (EDS; Genesis 7000, EDAX Inc., USA). The elemental compositions were analyzed via Xray photoelectron spectroscopy (XPS; AXIS-Ultra instrument, Kratos Analytical, England) with a monochromatic Al Ka X-ray beam (225 W, 15 Ma, 15 kV). The UV-Vis diffuse reflectance spectra (DRS) of the samples were measured with the diffuse reflectance accessory of UV-Vis spectrophotometer (UV-2550; Shimadzu, Kyoto, Japan), in which BaSO<sub>4</sub> was used as a background between 200–1200 scopes.



Fig. S1 | The work principle of pump probe setup. (a) The relationship between pump light and probe light in time domain and space domain. (b) The schematic diagram of pump probe setup.

Materials	Wavelength (nm)	τ <sub>1</sub> (fs)	τ <sub>2</sub> (ps)	Ref.
BQDs	970	194	15.1	This work
Graphene	-	210	1.67	ref.1
Cu <sub>2-x</sub> S	1300	315	34	ref. <sup>2</sup>
SnS	~1000	620	153	ref. <sup>3</sup>
WS <sub>2</sub>	~564–689	1300	100	ref. <sup>4</sup>
Graphdiyne	~ 900	1400	24	ref. <sup>5</sup>

Table S1	The relaxation time constants of current state-of-the-art materials.
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