

Supplementary information

Highly Luminescent MAPbI₃ Perovskite Quantum Dot with Simple Purification Process via Ultrasound-assisted Bead Milling

Junya Enomoto^a, Ryota Sato^a, Masaaki Yokoyama^a, Taisei Kimura^a, Naoaki Oshita^a, Kazuki Umemoto^a, Satoshi Asakura^b and Akito Masuhara^{*a, c}

^a *Graduate School of Science and Engineering, Yamagata University, 4-3-16, Yonezawa, Yamagata 992-8510, Japan.*

^b *ISE Chemicals Corporation, 1-3-1, Kyobashi, Chuo-ku, Tokyo, Japan.*

^c *Frontier Center for Organic Materials (FROM), Yamagata University, 4-3-16, Jonan, Yonezawa, Yamagata, 992-8510, Japan.*

*E-mail: masuhara@yz.yamagata-u.ac.jp

Phone: +81 238 26 3891; Fax +81 238 26 3891 (A.M.).

ORCID: 0000-0001-7108-959X

1. Supporting Results

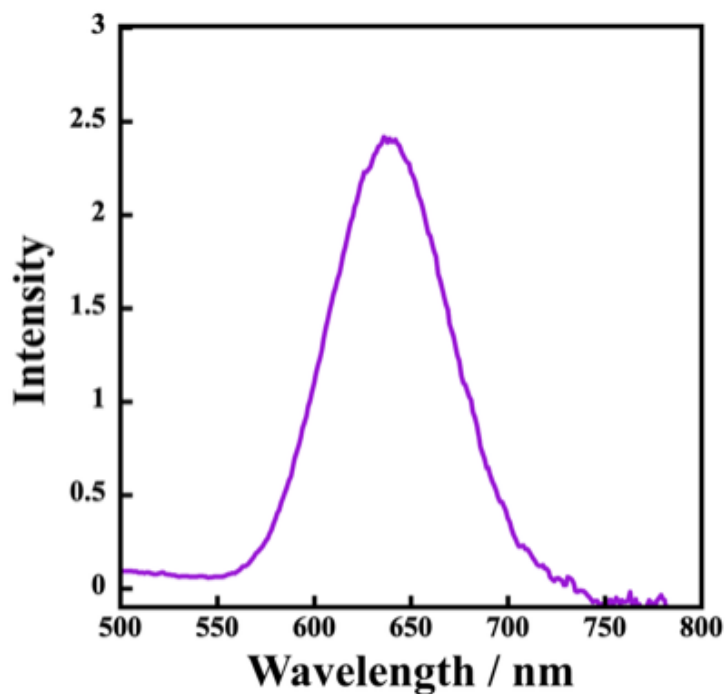


Fig. ES1 PL spectrum of Pbl₂ nanocrystals prepared using ultrasound-assisted bead milling.

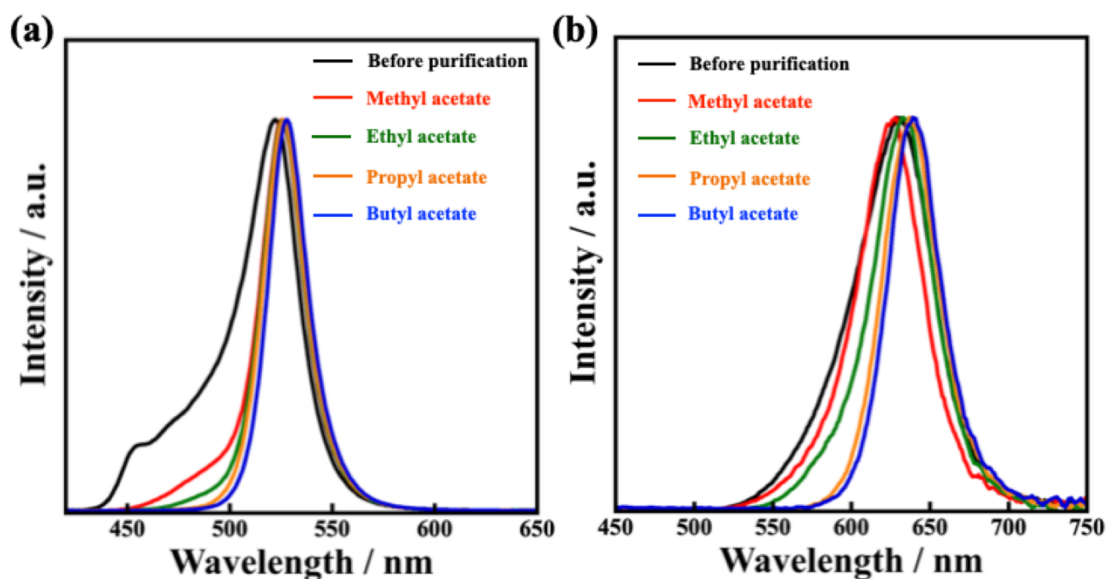


Fig. ES2 PL spectra of (a) MAPbBr₃ and (b) MAPb(Br/I)₃ QDs before purification and purified by methyl, ethyl, propyl, and butyl acetate.

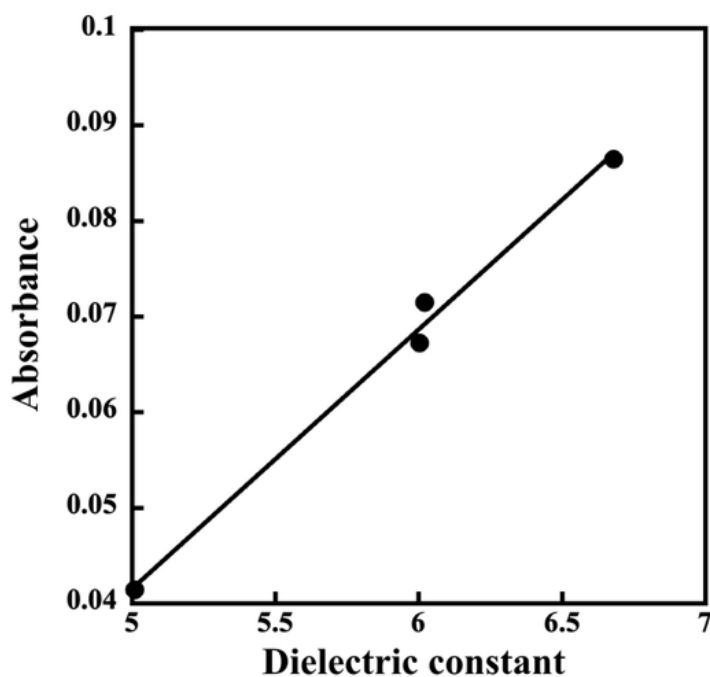


Fig. ES3 The relationship between absorbance at wavelength of 720 nm and dielectric constant of purifying solvents.

Table ES1 Summary of the properties including a maximum PL peak (λ_{PL}), FWHM, PLQY, average PL lifetime (τ_{Ave}), the average particle size (D) calculated from TEM. Comparison with MAPbI₃ QDs before purification, and purified by methyl, ethyl, propyl, butyl acetate, respectively.

Sample	λ_{PL} / nm	FWHM / nm	PLQY / %	τ_{Ave} / ns	D / nm
Before purification	739	60	57	32.0	7.2
Methyl acetate	741	48	63	46.3	11.3
Ethyl acetate	742	47	60	41.8	11.1
Propyl acetate	745	44	62	45.6	11.0
Butyl acetate	747	44	61	46.1	11.2

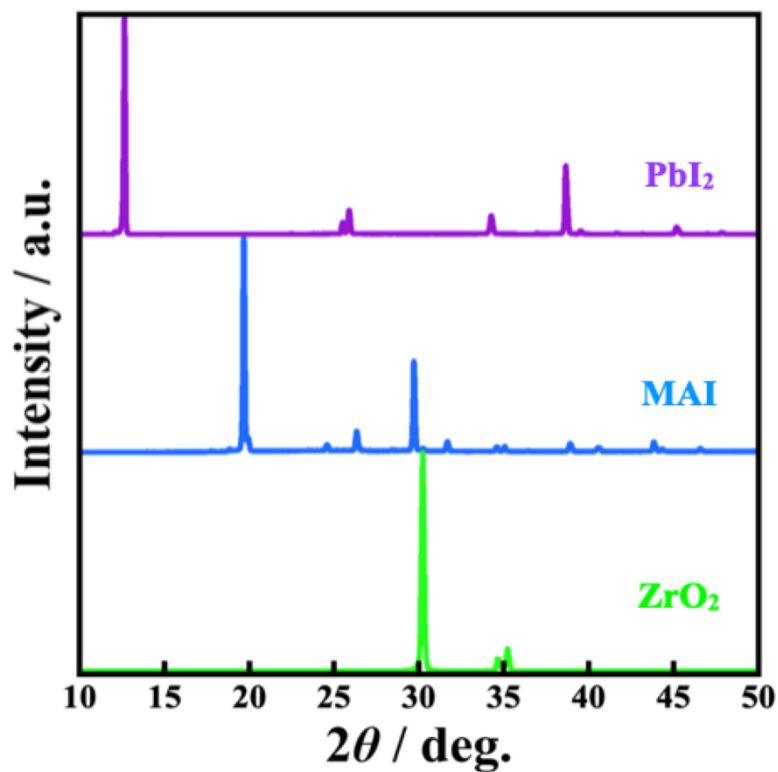


Fig. ES4 XRD patterns of PbI₂, MAI, and ZrO₂ beads.

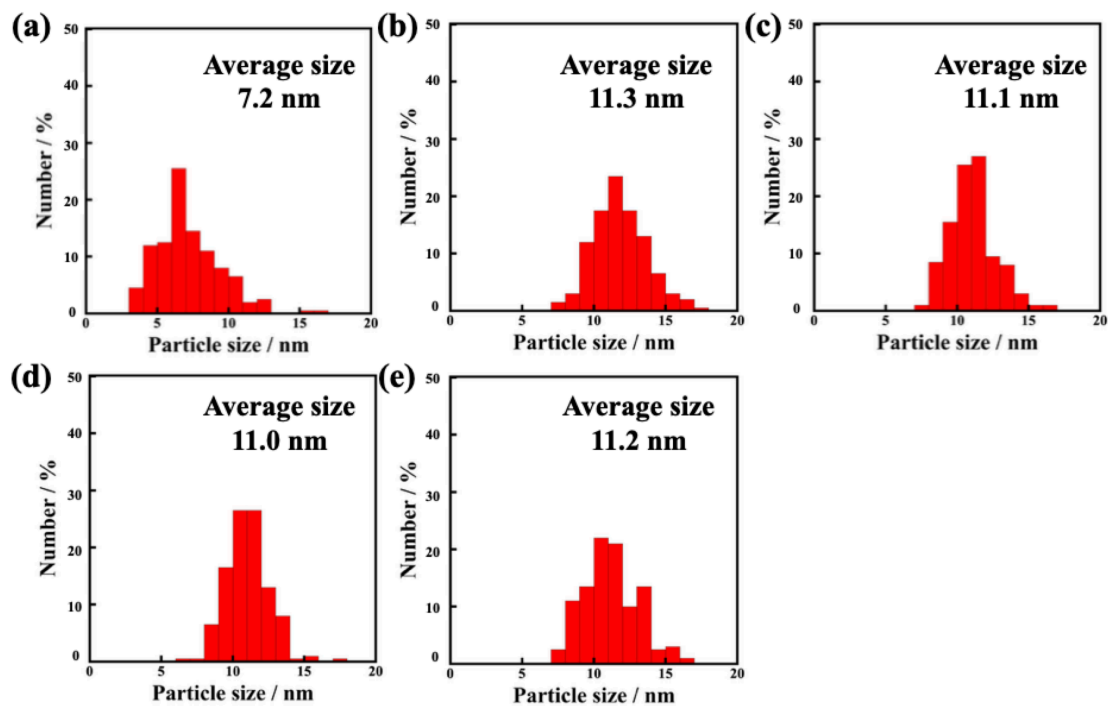


Fig. ES5 The size distribution of MAPbI₃ QDs (a) before purification, and purified by (b) methyl acetate, (c) ethyl acetate, (d) propyl acetate, (e) butyl acetate, respectively. Average size of MAPbI₃ QDs was determined by counting more than 200 QDs from TEM images.

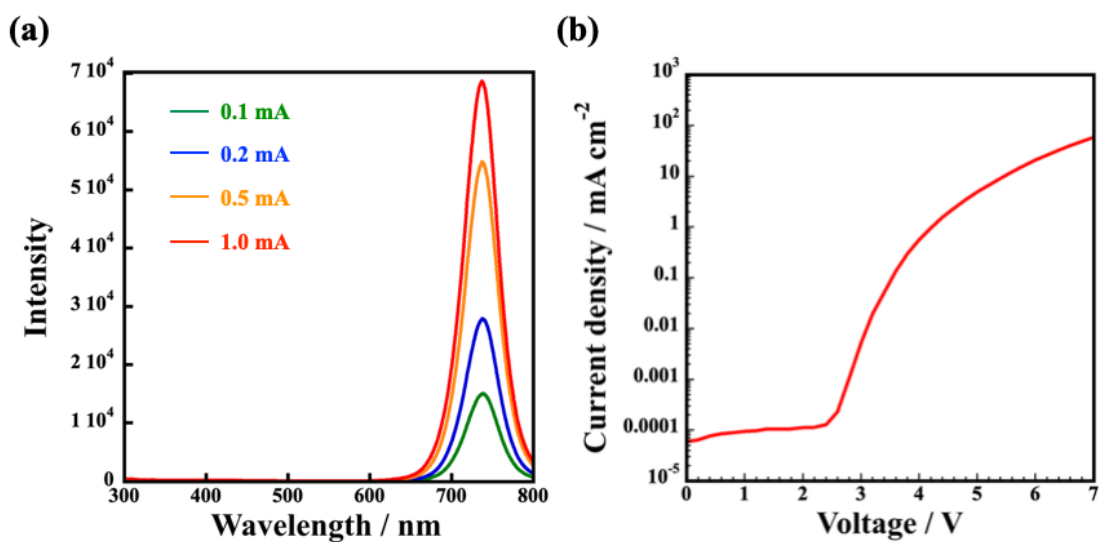


Fig. ES6 (a) EL spectra over electric current and (b) current density-voltage characteristics of the LED containing MAPbI₃ QDs purified by methyl acetate.