Supplementary Information

Piezoelectric Properties of $CH_3NH_3PbI_3$ Perovskite Thin Films and Applications for Piezoelectric Generators

Yun-Jeong Kim,[1] Tran-Van Dang,[1] Hyung-Jin Choi,[1] Byeong-Ju Park,[1] Ji-Ho Eom,[1] Hyun-A Song,[2] Daehee Seol,[3] Yunseok Kim,[3] Sung-Ho Shin,[4] Junghyo Nah,[4,*] and Soon-Gil Yoon[1,*]

[1]Department of Materials Science and Engineering, Chungnam National University, Daeduk Science Town, 34134, Daejeon, Korea

[2]Research Analysis Center, Korea Advanced Institute of Science and Technology, 291 Daehak-ro, Yuseong-gu, 34134, Daejeon, Korea

[3]School of Advanced Materials Science and Engineering, Sungkyunkwan University (SKKU), Suwon, 16419, Korea

[4]Department of Electrical Engineering, Chungnam National University, Daeduk Science Town, 34134, Daejeon, Korea

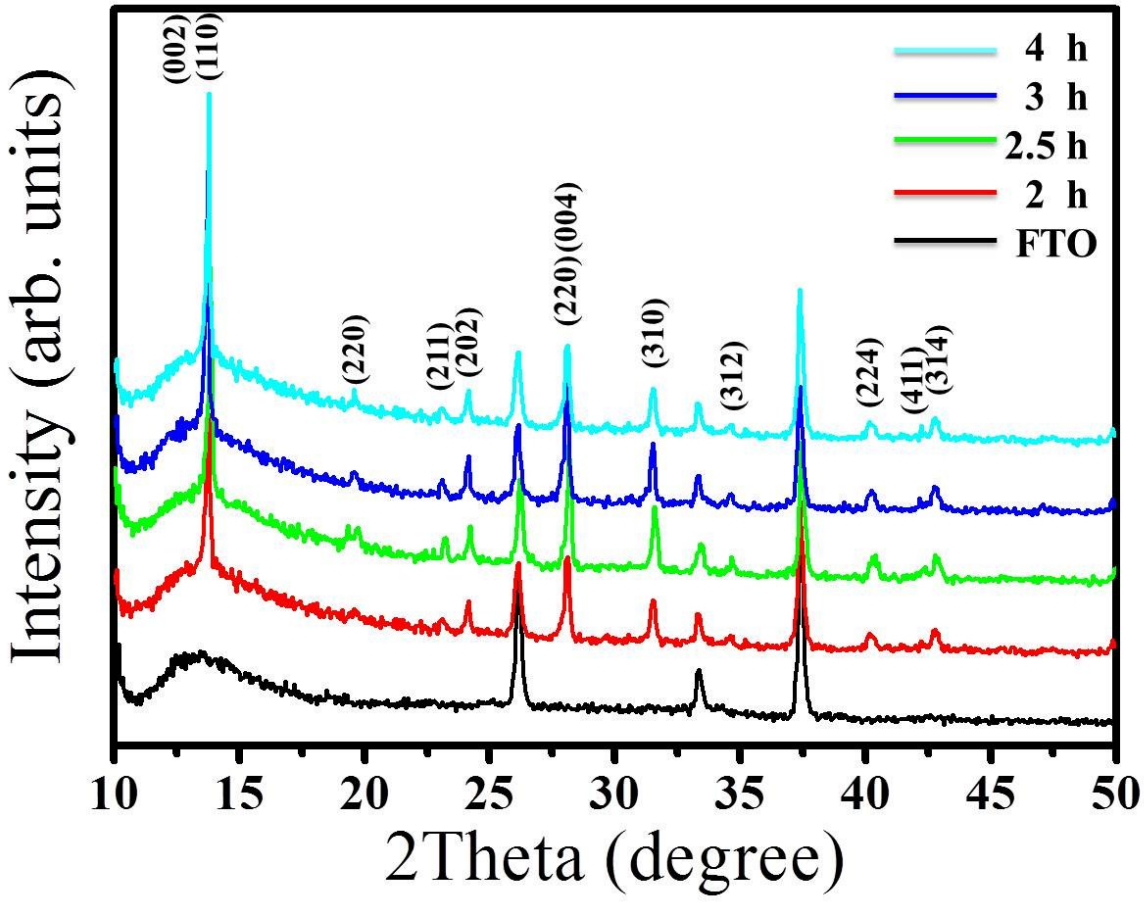

Fig. S1 XRD patterns of the $MAPbI_3$ films annealed at 100 °C for different times under ambient condition.

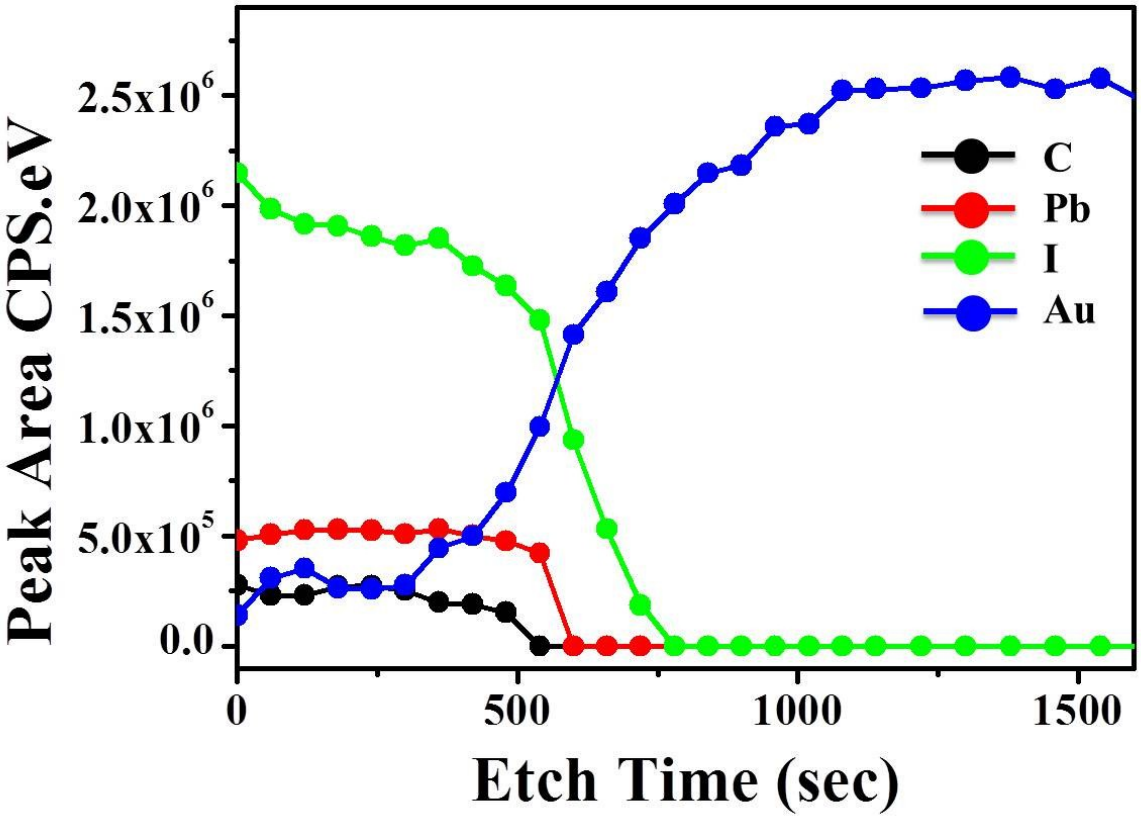

Fig. S2 AES depth-profile for the Pb, I, and C elemental distribution of the $MAPbI_3$ films deposited onto the Au (100 nm)/Ti (10nm)/glass substrate.

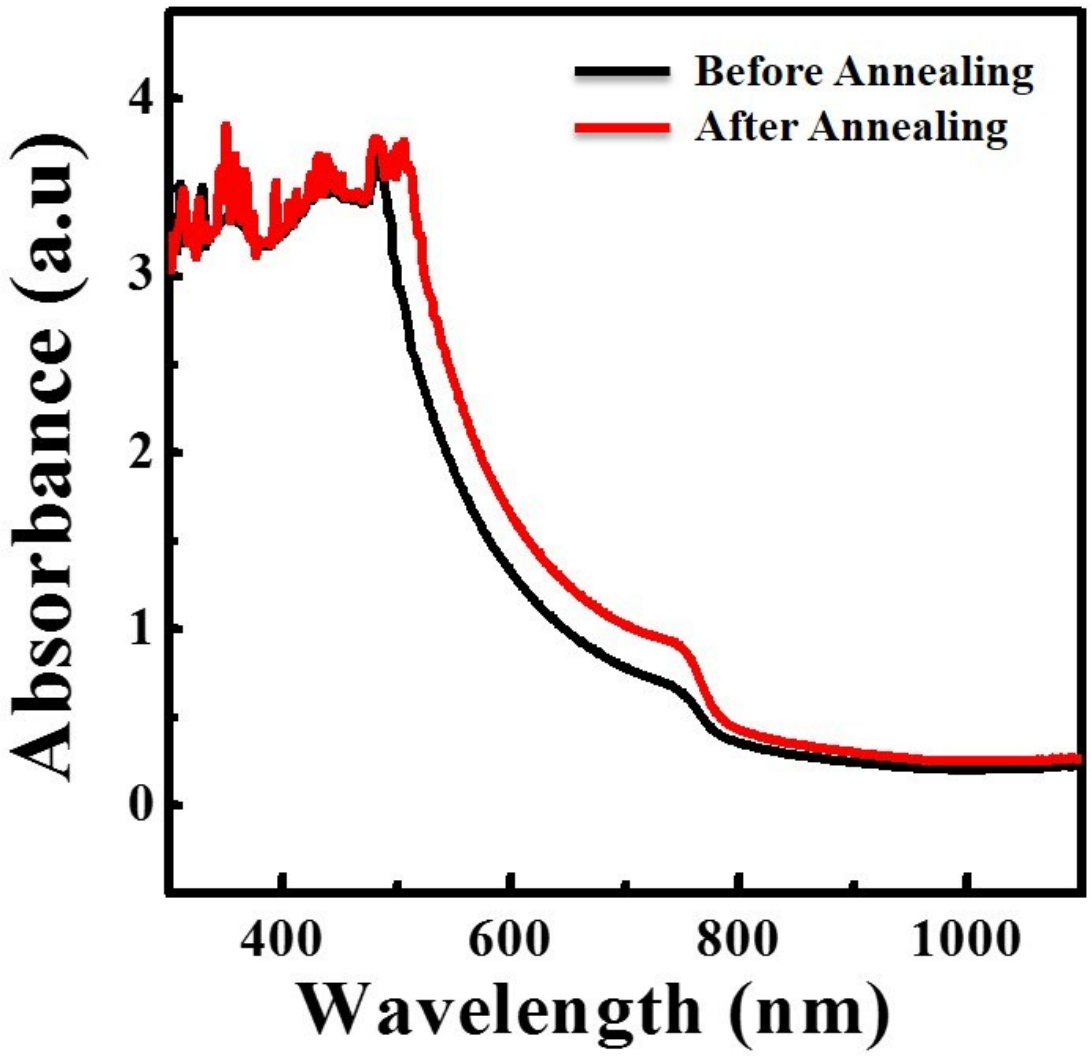

Fig. S3 Absorption spectra of the 500 nm-thick $MAPbI_3$ films before and after annealing at 100 ^oC for 1h. The $MAPbI_3$ films were deposited onto the FTO/glass substrate.

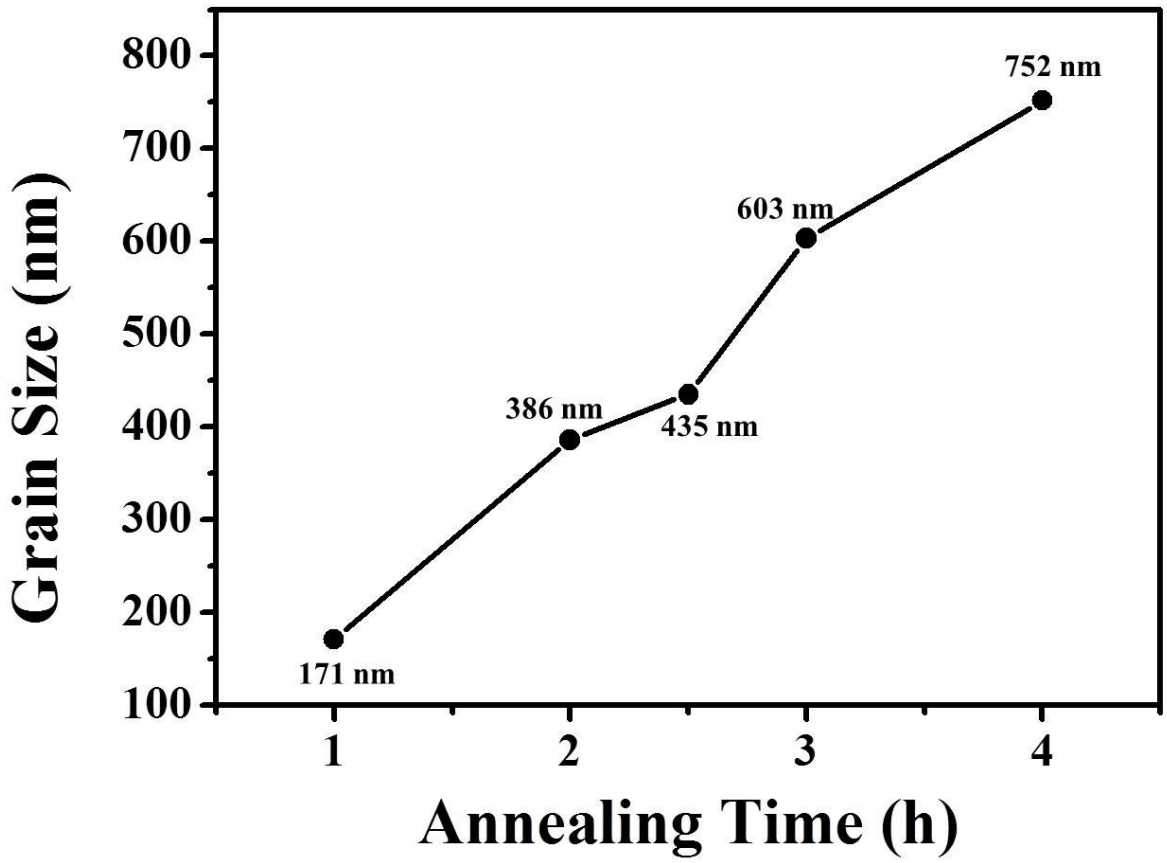

Fig. S4 Grain size vs. annealing time under an air atmosphere at 100 ^{o}C. The grain size of the $MAPbI_3$ films was determined using Scherrer formula via XRD.

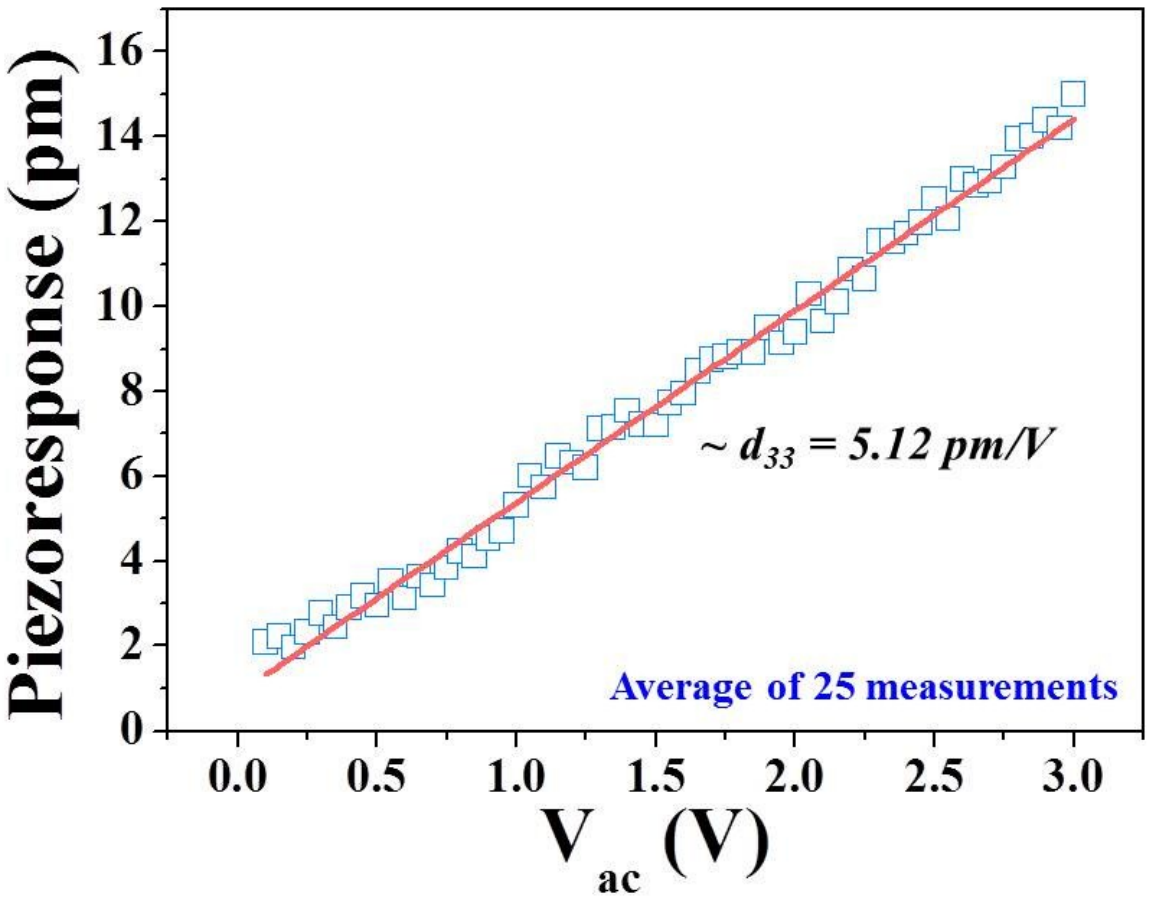

Fig. S5 The d_{33} piezoelectric coefficient of the $MAPbI_3$ films measured through the V_{ac} dependent piezoresponse measurements. The results were obtained by averaging the 25 measurements.

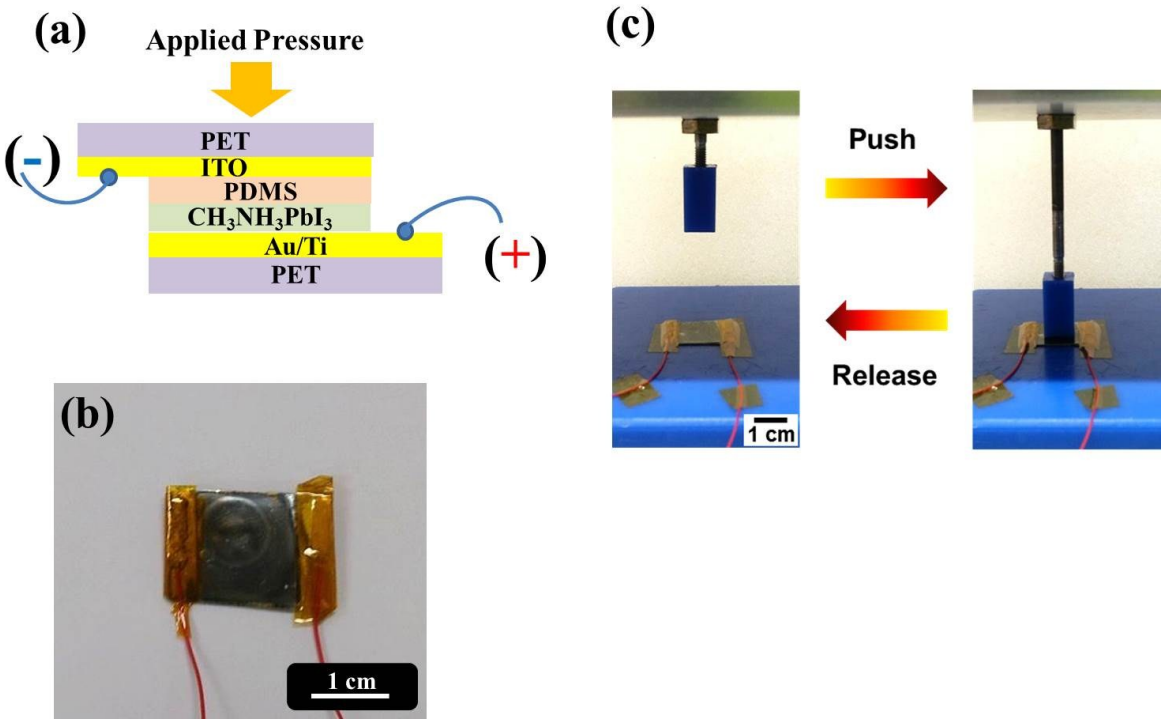

Fig. S6 (a) Schematic structure of the piezoelectric generator, (b) Photograph of the actual piezoelectric generator, and (c) Optical image of the measurement setup, providing push and release motions of the load onto the $MAPbI_3$ piezoelectric generator.

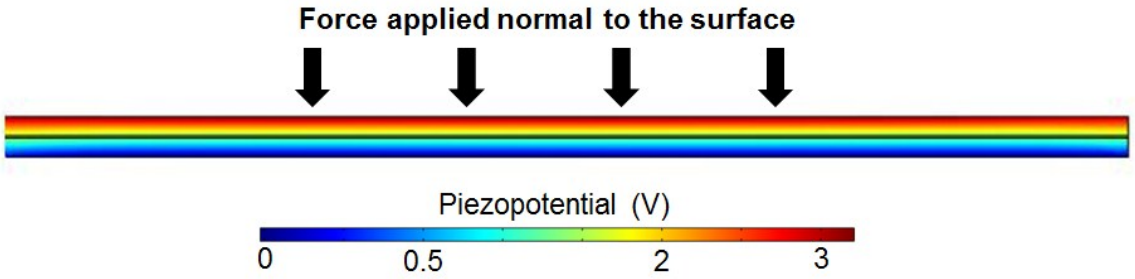

Fig. S7 Piezoelectric potential generated from the $MAPbI_3$ perovskite thin films calculated using COMSOL Multiphysics software. The thickness of the active film layer is 0.5 μm, the PET substrates (top and bottom) of 170 μm, and PDMS layer of 20 μm. The d_{33} of the film was set to 5.12 pm/V. The pressure (0.5 MPa) was applied normal to the surface of the $MAPbI_3$ thin films. The simulated colors in the figure were only indicated in the $MAPbI_3$ thin films.