ADVANCED ELECTRONIC MATERIALS
Open Access

Supporting Information

for *Adv. Electron. Mater.*, DOI 10.1002/aelm.202300475

Perovskite Thin Single Crystal for a High Performance and Long Endurance Memristor

Ismael Fernandez-Guillen, Clara A. Aranda, Pablo F. Betancur, Marta Vallés-Pelarda, Cristina Momblona, Teresa S. Ripolles, Rafael Abargues and Pablo P. Boix**

Supporting Information

Perovskite Thin Single Crystal for a High Performance and Long Endurance Memristor

Ismael Fernandez-Guillen[1], Clara A. Aranda [1,2,3]*, Pablo F. Betancur[1], Marta Vallés-Pelarda[1], Cristina Momblona[1,4,5], Teresa S. Ripolles[1], Rafael Abargues[1], Pablo P. Boix[1]*

[1]Instituto de Ciencia de los Materiales de la Universidad de Valencia (ICMUV), Spain

[2]Institute of Advanced Materials (INAM), University Jaume I, Castellon, Spain

[3]Center for Nanoscience and Sustainable Technologies (CNATS), Department of Physical, Chemical and Natural Systems, Universidad Pablo de Olavide, 41013, Seville, Spain.

[4]Instituto de Nanociencia y Materiales de Aragón (INMA), CSIC-Universidad de Zaragoza, Department of Chemical and Environmental Engineering, Universidad de Zaragoza, Campus Río Ebro-Edificio I+D, C/ Mariano Esquillor S/N, 50018 Zaragoza, Spain.

[5]Centro de Investigación Biomédica en Red de Bioingeniería, Biomateriales y Nanomedicina, Instituto de Salud Carlos III, 50018 Zaragoza, Spain.

Email: caranda@uji.es; *pablo.p.boix@uv.es*

Growing setup

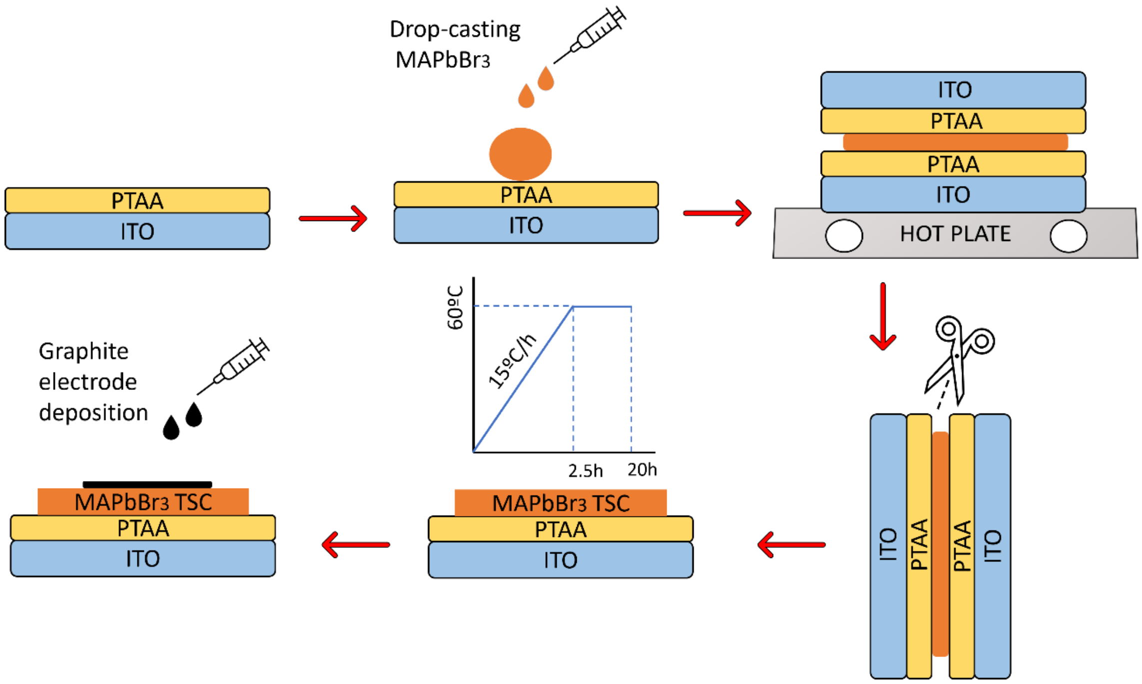

Fig. S1: **Scheme of confined ITC method for the TSC growing**. Note the lower temperature needed to obtain highly crystalline and reproducible single crystals. The temperature used in literature is up to 80ºC.

Optical Microscope

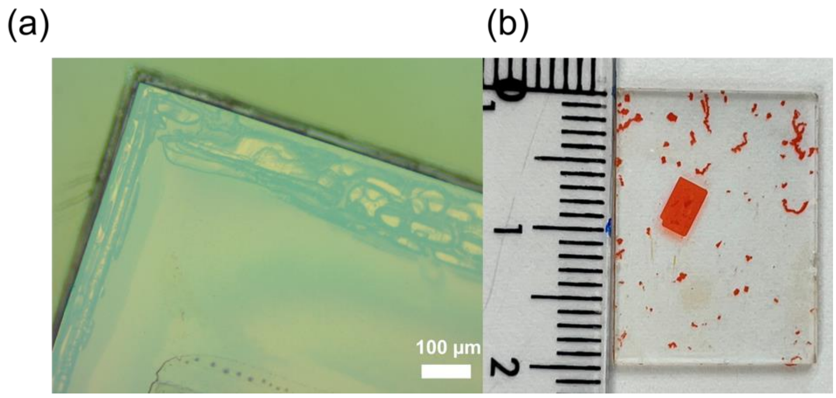

Fig. S2: **Optical microscope image of the TSC**. (a) Note the sharp corner showing a very crystalline square shape. (b) real image of one of the TSC synthesized through the confined ITC method.

Photoluminescence Steady State

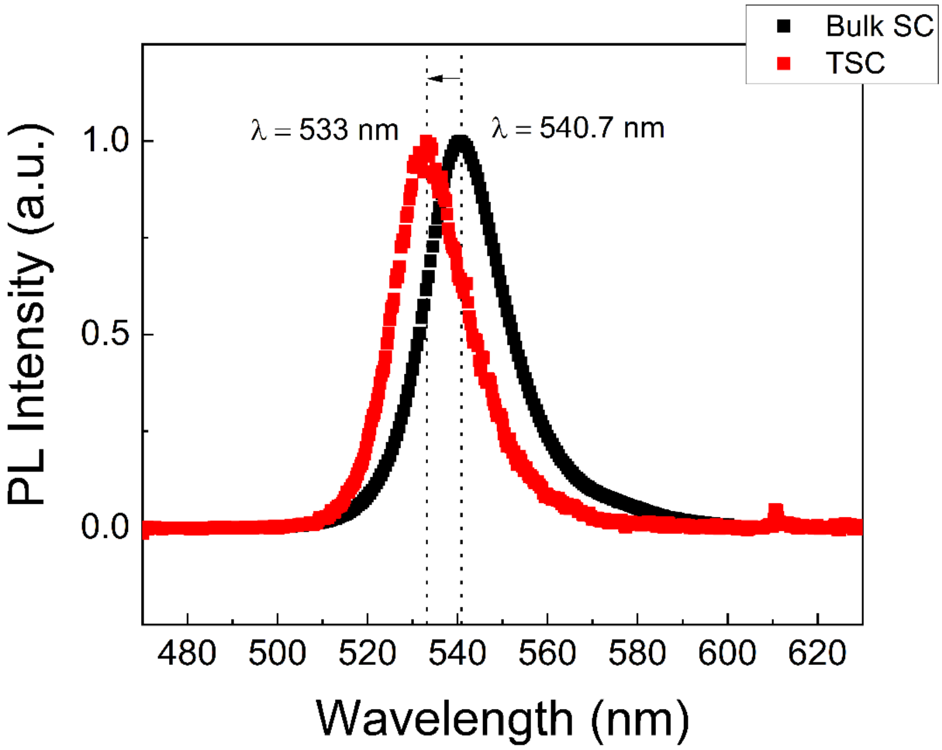

Fig. S3: **Photoluminescence spectra** of a bulk single crystal of 2 mm thickness (black) compared with the PL emission corresponding to the thin single crystals. Note the energetic increase due to the reduction of the thickness.

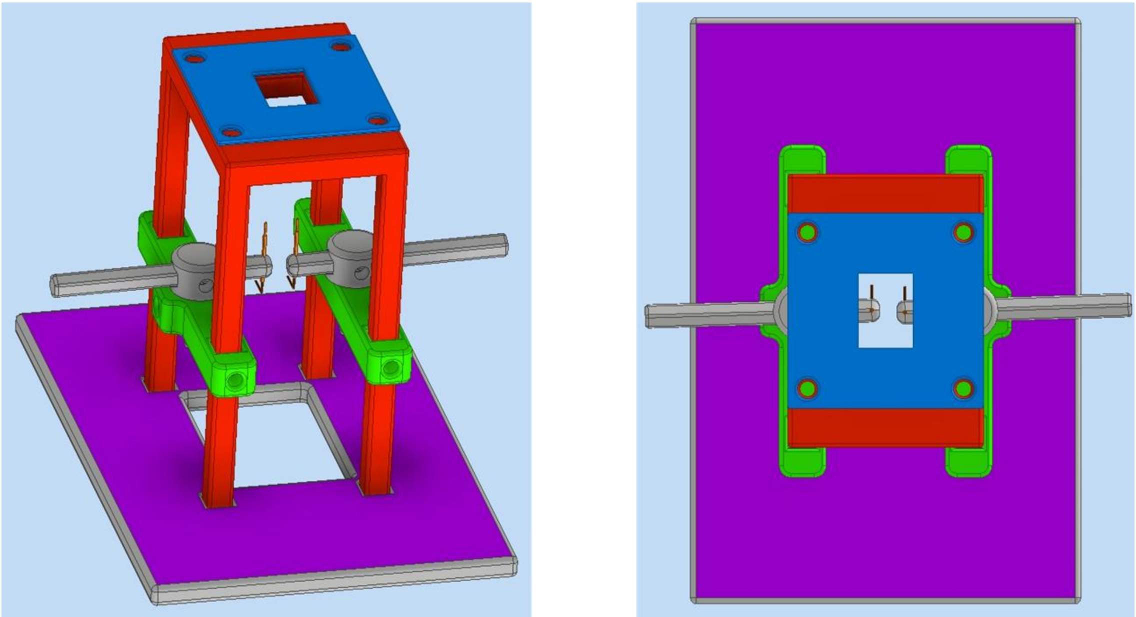

Fig. S4: **Scheme of the handmade sample holder used for the electronic measurement of the TSC.** The open window serves as the location for the ITO substrate containing the TSC, which can be illuminated if necessary. Green and grey parts are mobiles (green moves up and down throughout red supports and grey moves 360º of rotation), that allow us specifically to contact the SCF wherever it grows. Contact tips are retroactive contact made of stainless steel.

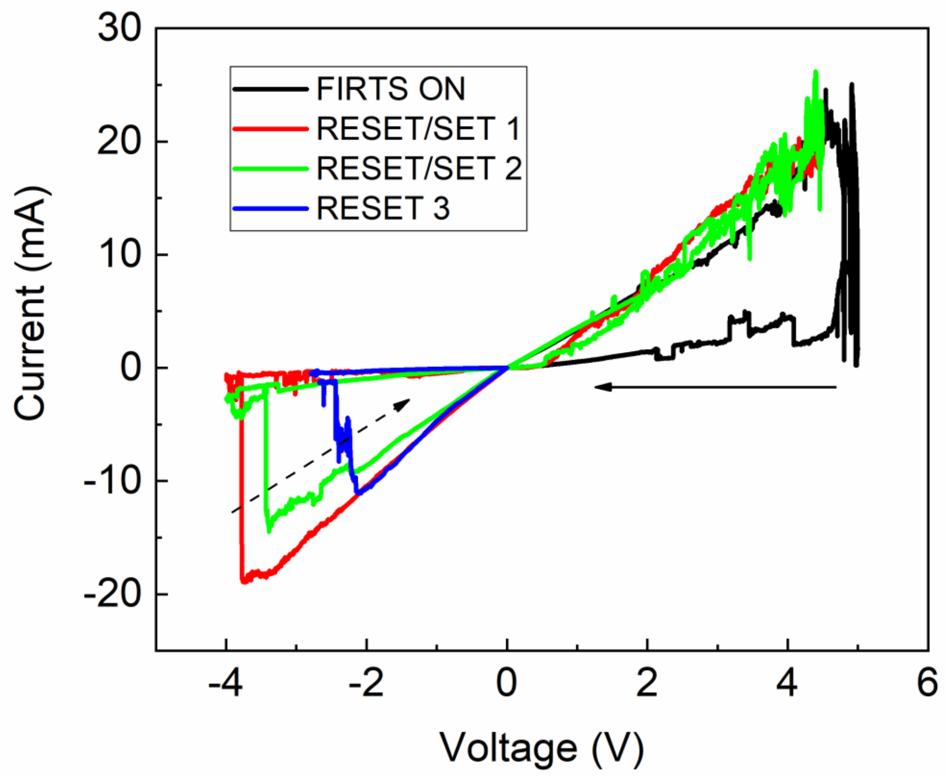

Fig. S5: CV curve showing the reduction of the voltage necessary to switch ON (black lines) and OFF (dashed black line) the memristor device; from red to blue.

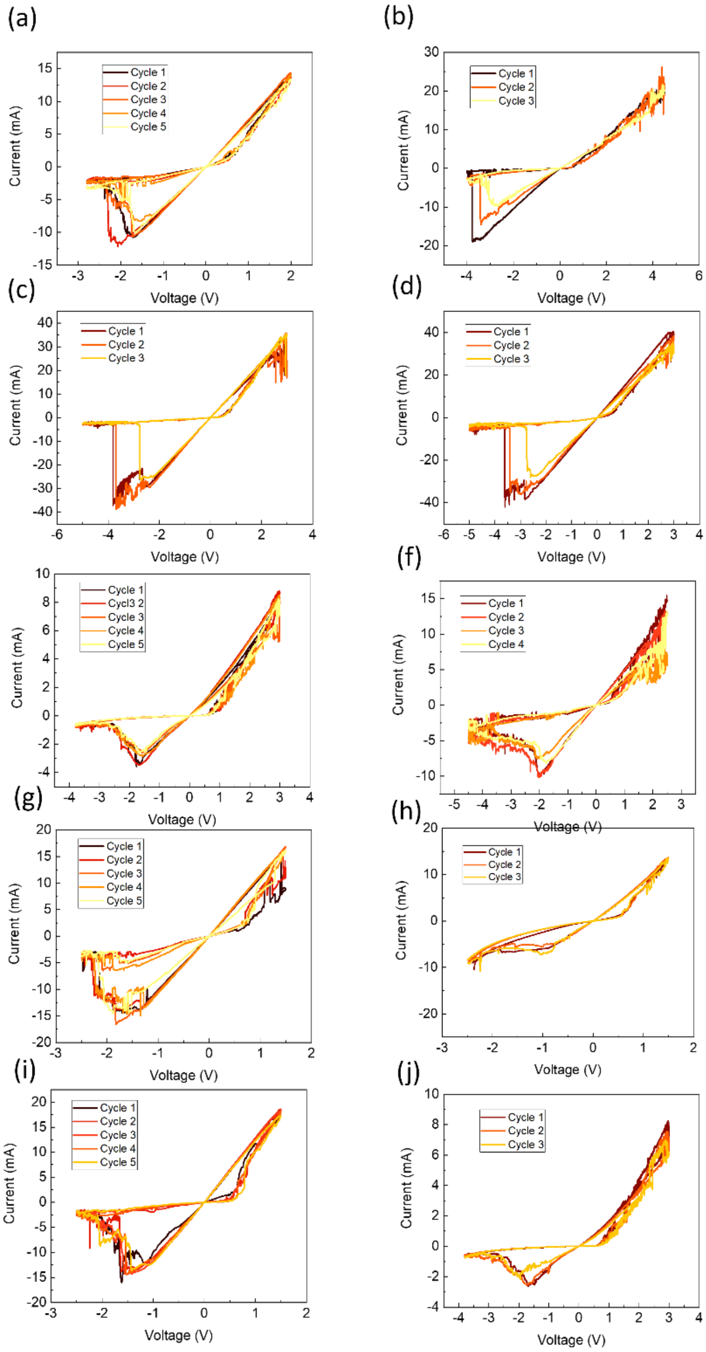

Fig. S6. Statistics of 10 devices characterized by jV curves.

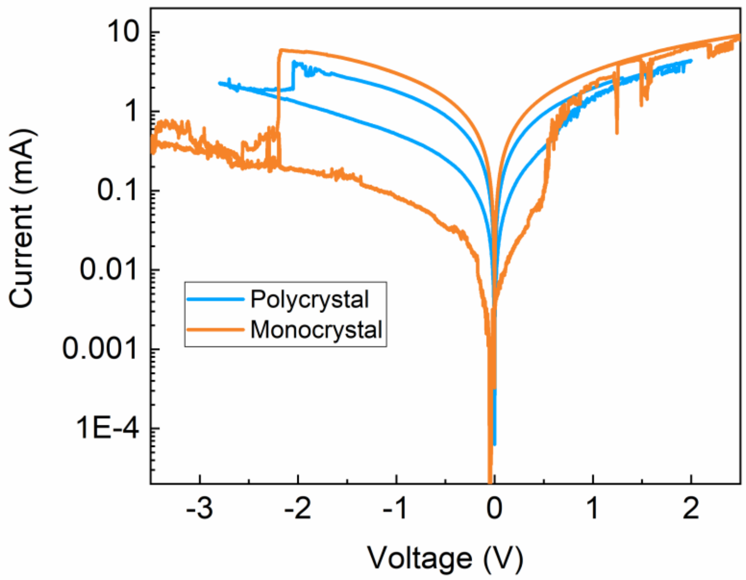

Fig. S7: Comparison between cyclic voltammetry curve for monocrystal device (orange curve) and polycrystal one (blue curve).

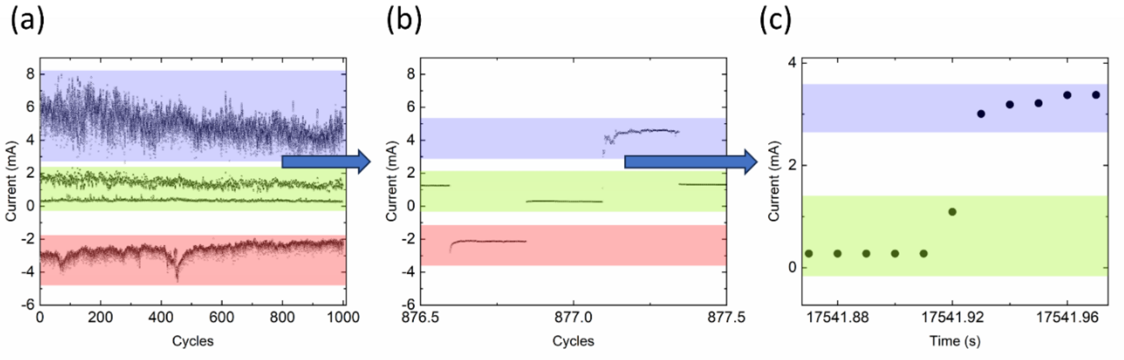

Fig. S8: Figure S8. (a) endurance test of 10^3 cycles for a typical device, (b) zoom of the cycle 877, (c) cycle 877 from LRS at lecture voltage to ON voltage fixed at 1 V, this figure is expressed over time. Where red rectangle represents the OFF voltage, blue rectangle the ON voltage and red one represents the read voltage.

R_L-L line effect on the functioning of the EC.

An inductor in an electronic circuit is usually a coil-shaped wire. When there is a change in voltage, the inductor generates a magnetic field that resists the change in electric current flowing through it, governing the high-frequency part of the spectra. This resistance is called inductance, represented by L.

In our case, the different speeds of species (charges and ions) induce a delay in the response of the system that is represented as a negative capacitance in the low-frequency domain with a time constant associated, τ_{kin}.

The AC impedance response can be expressed as follows:

$$Z = \frac{\hat{V}}{\hat{j}} = \left[i\omega C_d + \frac{1}{R_L + i\omega L} + \frac{1}{R_{rec}} + \frac{1}{R_C - i\frac{1}{\omega C_1}}\right]^{-1} \quad \text{(S1)}$$

$$R_{rec} = \frac{\beta k_B T}{q\bar{J}_{rec}} \quad \text{(S2)}$$

$$R_L = \frac{\gamma k_B T}{q\bar{J}_{rec}} \quad \text{(S3)}$$

$$L = \frac{R_L}{\tau_{kin}} \quad \text{(S4)}$$

$$R_C = \frac{b\tau_{kin}}{C_1} \quad \text{(S5)}$$

Where j_{rec} is the recombination current at steady state, β and γ exponents are constants with values ≤ 1 and b is a correction factor for the fitting, with $k_B T$ as the thermal energy.