# Supporting Information for

# High-k dielectric screen-printed inks for mechanical energy harvesting devices

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Additional Experimental Information, Figures and Tables

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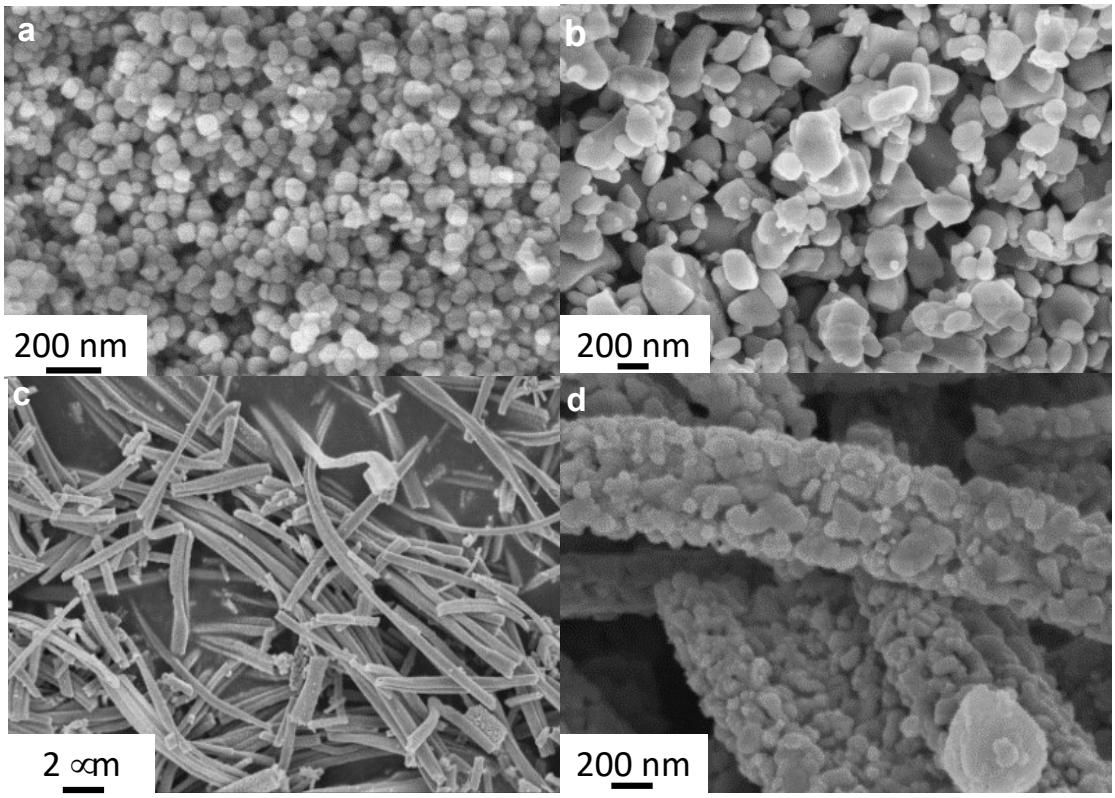


**Figure S1** SEM images of a,b) as-received commercial BTO spherical nanoparticles and c,d) as-produced BSTO nanofibers produced by Pardam.

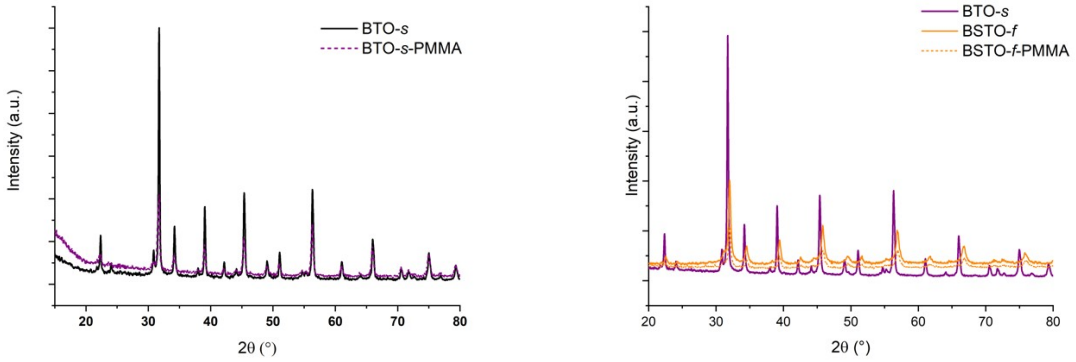

Figure S2 XRD diffractograms of BTO-*s* **(left)** and BSTO-*f* **(right)** before and after functionalization with PMMA

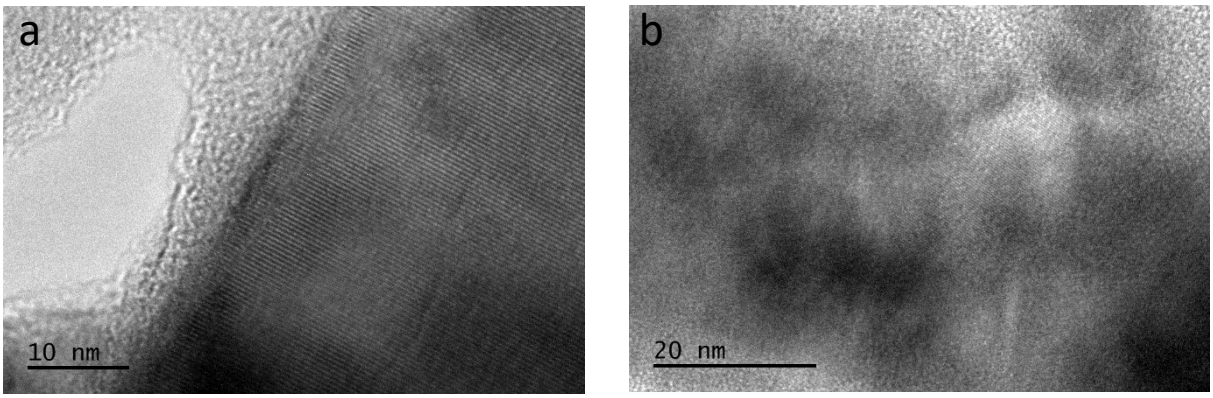


**Figure S3** High resolution TEM images of BSTO fibers before a) and after b) polymerization of MMA from the brominated surface. It was not possible to fully resolve the crystal structure in the BSTO-*f* post-functionalisation b), but the lattice can be seen clearly in a) before polymer grafting.

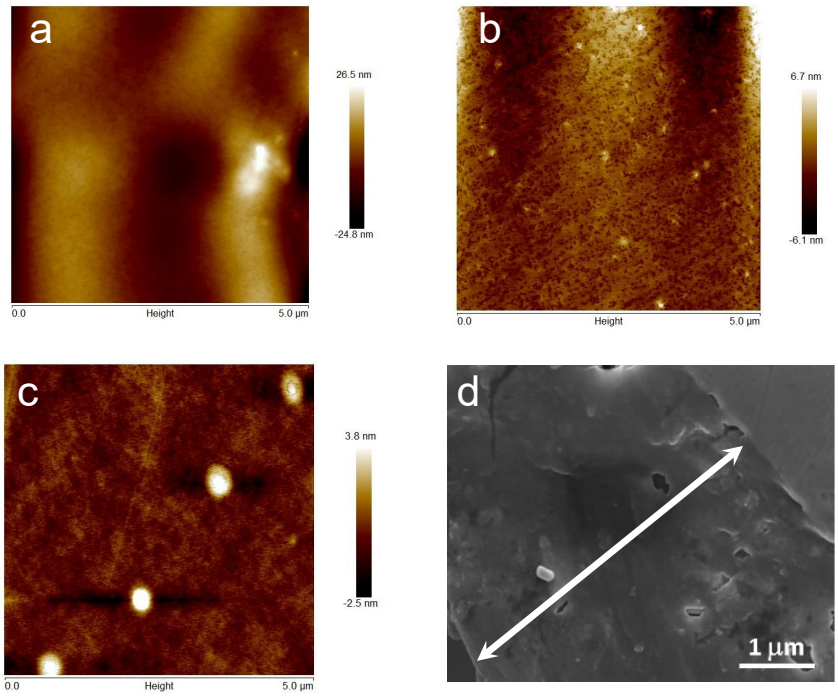


**Figure S5** AFM images to assess the surface roughness of BSTO-*f*-PMMA-epoxy (φ=0.05) printed dielectric films and drawn down dielectric films a) root mean square (RMS) ~ 28 nm using a 90T polyester screen mesh, b) RMS ~ 11 nm using a 110T polyester screen mesh and c) and RMS ~ 4 nm with areas of larger particulates when using a draw-down bar to create a dielectric film d) is a typical cross-section of the printed BSTO-*f*-PMMA dielectric films.

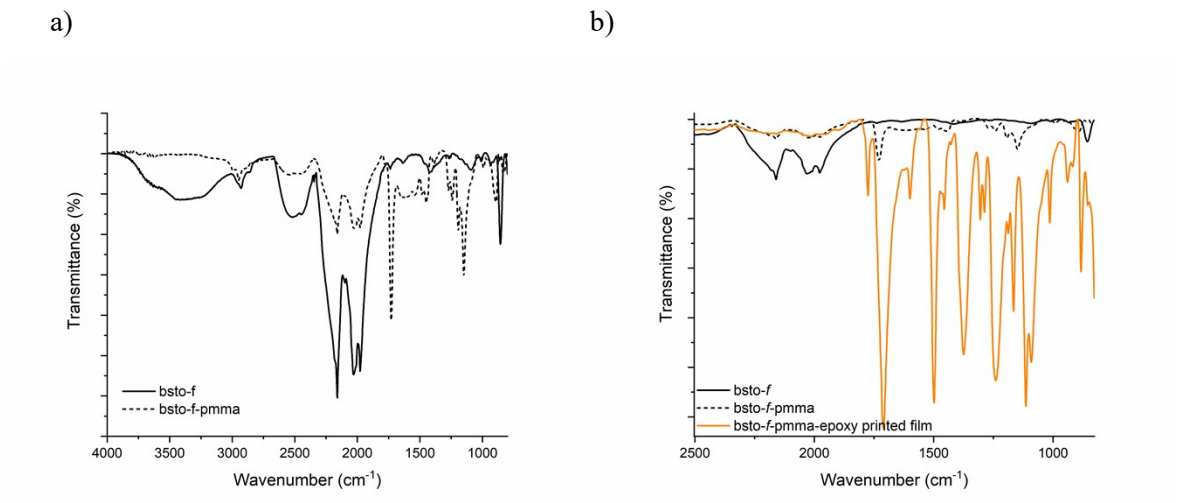


Figure S4 FTIR of a) BSTO-*f*, polymer functionalized BSTO-*f*-PMMA and b) the printed BSTO-*f*-PMMA-epoxy printed dielectric ink

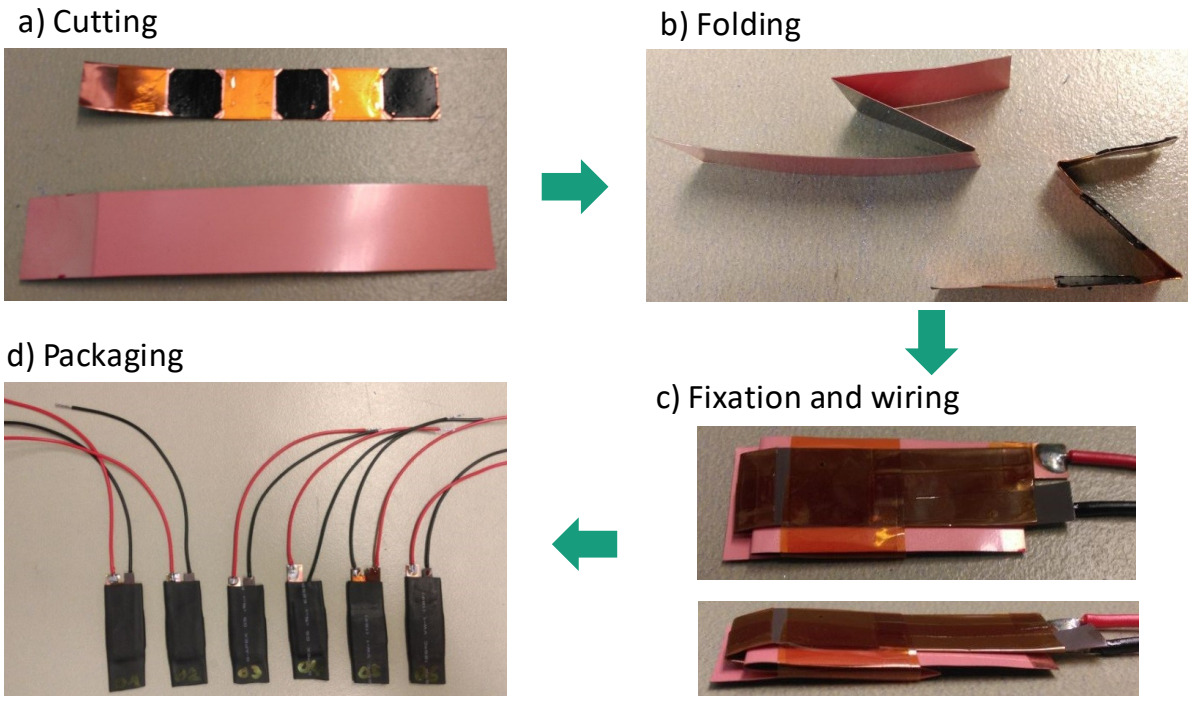


**Figure S5** Mechanical energy harvesting device preparation; once the elastomer, spring element and printed dielectric are prepared they are a) cut into shape, b) folded in a concertina shape to integrate the conductive elastomer with the dielectric layer c) the wiring is soldered in place and d) packaged in a cell.

Table S1 Summary of dielectric loss and breakdown strength.

| Printed sample | tan δ[a] | Breakdown Strength (V μm$^{-1}$) |
|---|---|---|
| BSTO-*f*-PMMA-epoxy | 0.10 | 103±18 |
| BTO-*s*-PMMA-epoxy | 0.20 | 100±20 |
| Epoxy | 0.50 | 220±10 |

[a.] at 1kHz

**Table S2** Summary table of dielectric composites in literature where the ceramic ferroelectric filler is BTO or STO and functionalized with polymer. The values are presented graphically in Figure 4 in the main manuscript document.

| Ferroelectric Ceramic | Functionalised Polymer | Volume Fraction in composite | Frequency (kHz) | Dielectric Constant, $\varepsilon$ | Ref. |
|---|---|---|---|---|---|
| BTO | PMMA | 0.30 | 0.001 | 15 | [1] |
| BTO | PMMA | 0.65 | 0.01 | 100 | [2] |
| BTO | PMMA | 0.30 | 0.001 | 13 | [3] |
| BTO (Zr)/PVP | PMMA | 0.18 | 0.1 | 56 | [4] |
| BTO-STO | PVDF | 0.15 | 1 | 14.9 | [5] |

| | | | | | |
|---|---|---|---|---|---|
| BTO | PVDF | 0.20 | 0.1 | 30 | [6] |
| BTO | PVDF | 0.50 | 1 | 37 | [7] |
| BTO | PVDF-HFP | 0.50 | 1 | 43 | [8] |
| BTO | PVDF-g-HEMA | 0.20 | 1 | 75 | [9] |
| BTO | PVDF-HFP | 0.50 | 1 | 49 | [10] |
| BTO (Zr)/PVP | PVDF | 0.08 | 1 | 18 | [11] |
| BTO fibres* | PVDF | 0.20 | 0.001 | 23 | [12] |
| STO fibres* | PVDF | 0.10 | 1 | 18 | [13] |
| BTO | HBP/PMMA | 0.57 | 1 | 39 | [14] |
| BTO | PS-b-P4VP(PDP) | 0.50 | 1 | 32 | [15] |
| BTO | PEN | 0.05 | 0.1 | 9.5 | [16] |
| BTO | Silane | 0.60 | 0.1 | 52 | [17] |
| BTO | PS | 0.40 | 1 | 32 | [18] |
| BTO | PS | 0.59 | 1 | 33.1 | [19] |
| BTO | PEDOT | 0.25 | 1 | 25 | [20] |
| BTO | PGMA | 0.05 | 1 | 54 | [21] |
| BTO | PHFDA | 0.50 | 1 | 45 | [22] |
| BTO | PDA/PLA | 0.20 | 0.001 | 10 | [23] |

* Produced by electrospinning

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