Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A
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Largely enhanced energy density in flexible P(VDF-TrFE) nanocomposites by surface-modified electrospun $BaSrTiO_3$ fibers

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Electronic supplementary information

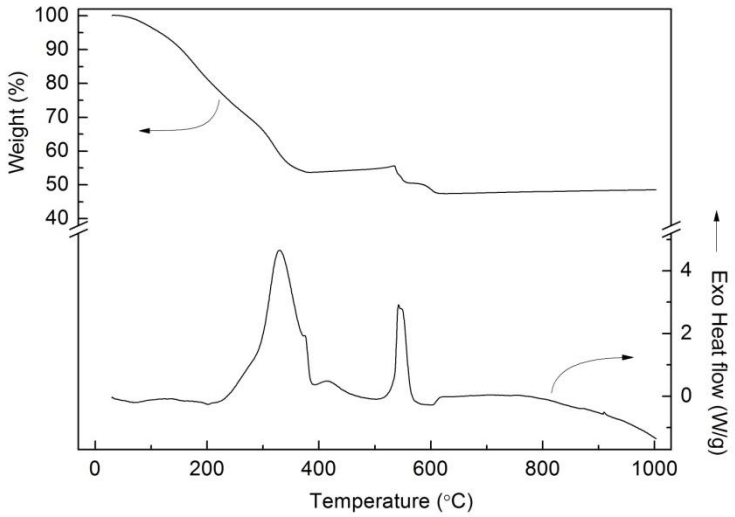

Figure S1. Differential scanning calorimetry and thermo-gravimetric analysis of the as-electrospun BSBT fibers.

The DSC and the TG measurements on the electrospun fibers are shown in Fig. S1. There are two exothermic heat flow peaks in the DSC curve, where the first one at 300~400 ^{o}C reveals the burning of the organic and the second one at about 550 ^{o}C indicates the temperature of crystallization of the BSBT. Theoretically, high temperature can accelerate the crystallization; however, the grains of the BSBT will grow larger at a heat treatment above 800 ^{o}C, resulting in granulation and decrease the density of the fibers (See Fig. S2). So a heat treatment of calcined at 700 ^{o}C was employed to get well crystallized and dense BSBT nanofibers.

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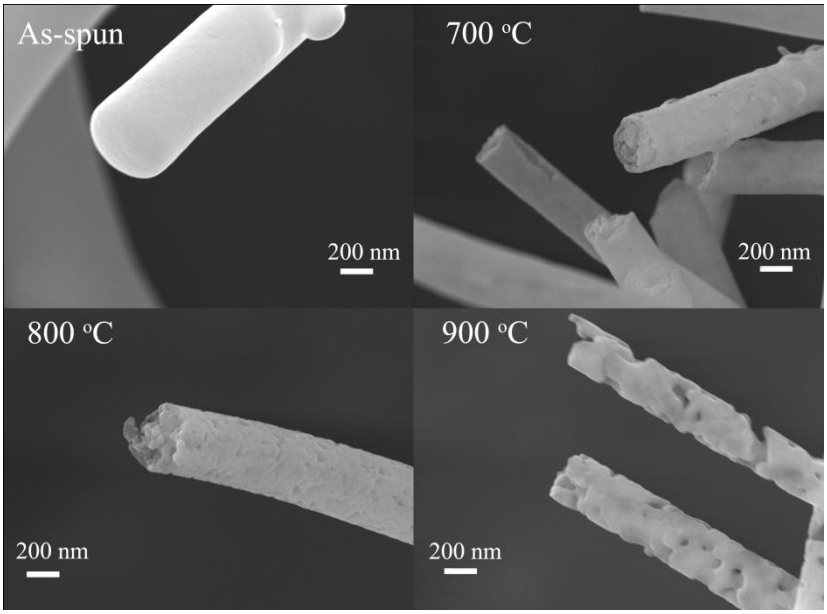

Figure S2. SEM images of the calcined BSBT fibers treated at different temperatures for same time.

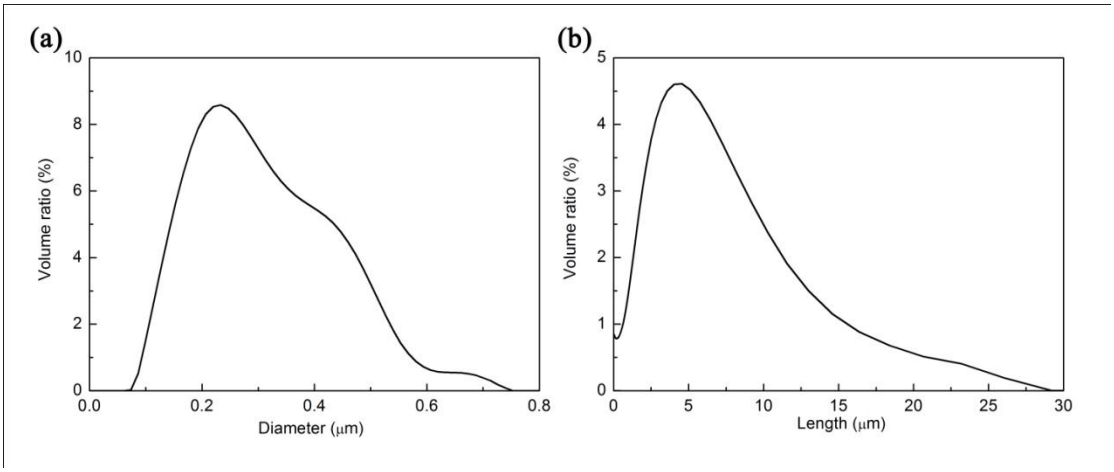

Figure S3. The size distribution of (a) diameter and (b) length of the dopamine modified BSBT nanofibers.

After ultrasonication and stirring in aqueous solution in the surface modification process, the mean length of the BSBT fibers was several micrometers with an average aspect ratio about 20, as shown in the size distribution in Fig. S3.

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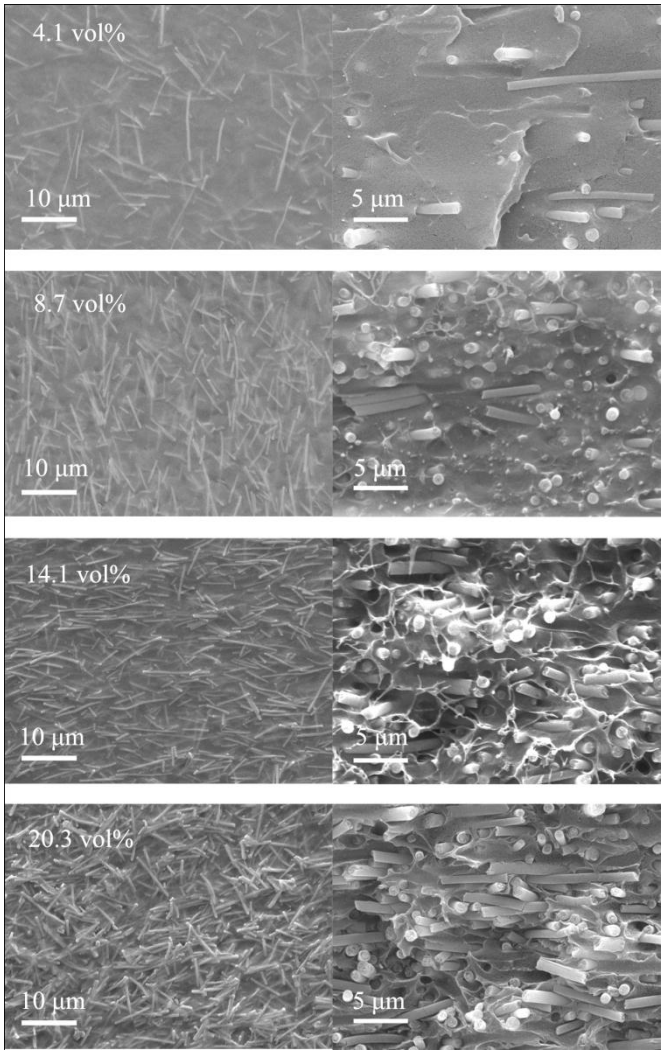

Figure S4. In-plane and cross-section SEM morphologies of the BSBT/P(VDF-TrFE) composite films with a series of fibers volume fraction.

Fig. S4 shows the in-plane and cross-section SEM morphologies of the BSBT/P(VDF-TrFE) composite films with a series of fibers volume fraction. The SEM images indicate that the composite films with low fibers loading (Such as the 4.1 vol% one) are dense, but defects such as microcracks and voids introduced with the fillers increase with the fibers loading rising. On one hand, the imperfections lead to the concentration of the local electric charge. On the other hand, high loading of fillers also raises the chance of interconnection between the fibers to facilitate the charge transferring along the electric field direction. Consequently, the leakage current is increased while the breakdown strength is reduced in the composite with high BSBT fibers loading.

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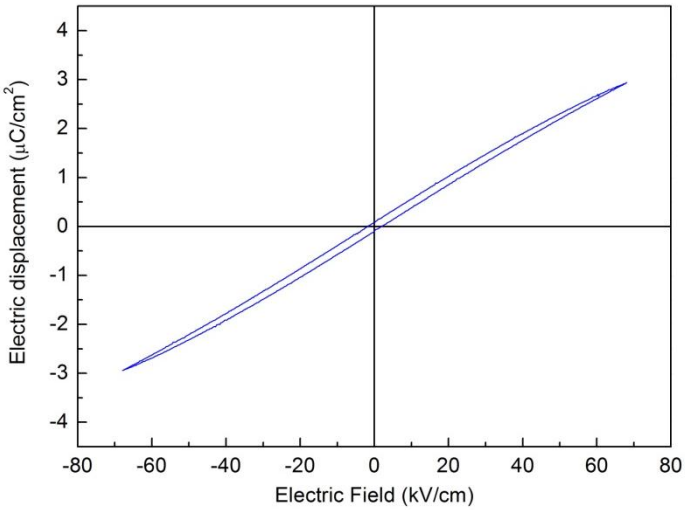

Figure S5. *D-E* loops of the sintered BSBT ceramic pellet pressed using calcined fibers.

For the ferroelectrics, the electric displacement is not linearly dependent on the electric field, the energy density of which should be computed from the D-E loops based on the following formula,[1]

$$U_e = \int EdD$$

where U_e is discharged energy density, E is the electric field and D is the polarized displacement. P(VDF-TrFE) is an excellent ferroelectric polymer, and the U_e of which is limited by its high remanent polarization (P_r) of ferroelectric polarization behavior. The BSBT fiber fillers are paraelectric phase dielectric and indicate linear polarization behavior as shown in Fig. S5. The introduction of BSBT fibers decreased the P_r and largely increased the storage energy density of the composite.

[1] W. M. Xia, Z. Xu, F. Wen, Z. C. Zhang, *Ceram. Int.* **2012**, *38*, 1071.