Highly enhanced energy density induced by hetero interface in sandwich-structured polymer nanocomposite

Penghao Hu*, Jianjun Wang, Yang Shen*, Yuhan Guan, Yuanhua Lin, and Ce-Wen Nan* E-mail: penghaohu@gmail.com; shyang_mse@tsinghua.edu.cn; cwnan@tsinghua.edu.cn

Electronic supplementary information

In the nanocomposites, the target volume fractions (vol%) of the fillers were converted to the weight fractions (wt%) by the following equation,

$$wt\% = \frac{\frac{vol\% \cdot \rho_f}{(1 - vol\%) \cdot \rho_m}}{1 + \frac{vol\% \cdot \rho_f}{(1 - vol\%) \cdot \rho_m}} = \frac{vol\% \cdot \rho_f}{(1 - vol\%) \cdot \rho_m + vol\% \cdot \rho_f} \times 100\%$$

where the ρ_f and ρ_m are densities of filler and the matrix, respectively. For the densities of the BSBT nanofibers, the TO nanoparticles and the PVDF, a hot pressed pellet of each was measured by drainage method to estimate the density.



Figure S1. (a) In-plane and (b) cross-section SEM morphology of the BSBT-nf/PVDF nanocomposite film with 3 vol% BSBT nanofiber loading.



Figure S2. D-E loops of the BSBT-nf/PVDF nanocomposites with different BSBT nanofibers loading.

The *D*-*E* loops of PVDF-based nanocomposite films with TO nanoparticles are show in the Figure S3. The 10 vol% and 20 vol% loading samples exhibit low *D* and low remanent polarization (energy loss), and the 30 vol% loading sample represents high *D* but large energy loss. However, the breakdown strength is decreased with the TO loading rising, and in the film with more than 30 vol% TO loading, the E_b will be highly reduced, and the maximal *D* is low either due to low applied electric filed. So we selected the 30 vol% TO loading which possesses large *D* and moderate E_b to add into the sandwich film. In the sandwich structure film with 30 vol% TO in the outer layers, the electric displacement is increase and the energy loss can be reduced by the central BSBT-nf/PVDF layer (See Fig. 3 in the main text), resulting in enhancement on the energy density.



Figure S3. D-E loops of the single layer film of TO-np/PVDF with different TO nanoparticles loading.



Figure S4. D-E loops of the single layer film of TO-np/PVDF with 30 vol% TO nanoparticles.