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Giant Piezoelectric Nanocomposites Integrated in Physically Responsive Field-effect Transistors for Pressure Sensing Applications

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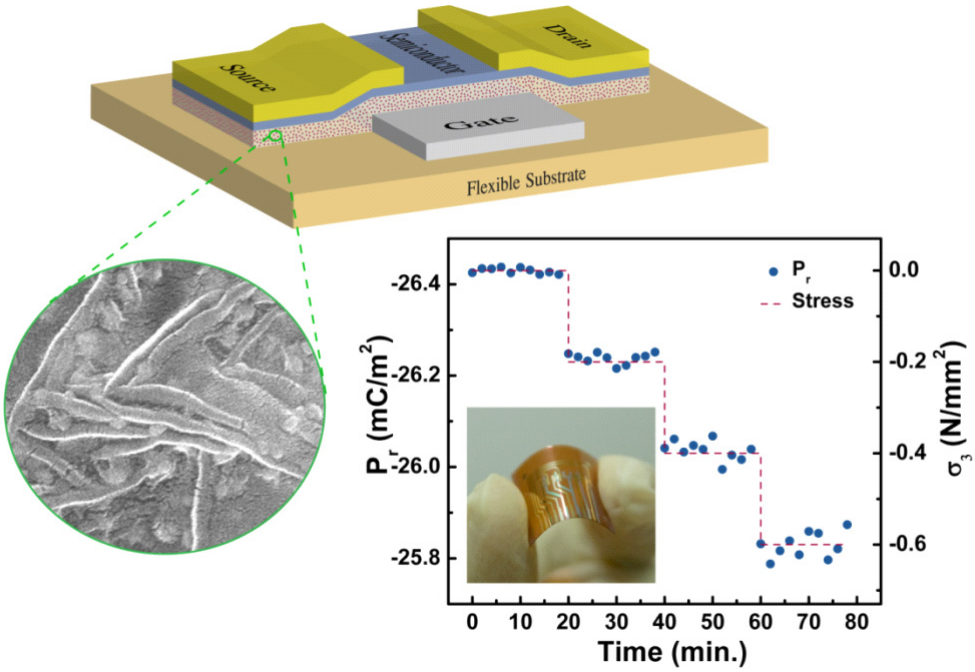
Physically responsive field-effect transistors (physi-FETs), which are sensitive to physical stimuli, have been studied for decades. However, the primary issue of separating responses by sensing materials from interferences by other subcomponents in a FET transducer under global physical stimuli has not been completely resolved. Recent challenges of structural design and employing smart materials with a large electro-physical coupling effect for flexible physi-FETs still remain. In this article, we propose directly integrating nanocomposites of barium titanate (BT) nanoparticles (NPs) and highly crystalline poly(vinylidene fluoride-trifluoroethylene) (P(VDF-TrFE)) as gate dielectrics into flexible organic FETs to precisely separate and quantify tiny variations of remnant polarization caused by mechanical stimuli. Investigations under static stimuli resulted in first-reported giant-positive piezoelectric coefficients of d_{33} up to 960 pC/N, presumably due to significant contribution of the intrinsic piezoelectricity of BT NPs and P(VDF-TrFE) crystallites. This approach provides a general research direction, and not limited to physic-FETs.

Keywords: FETs, Sensor, P(VDF-TrFE)


Source
Semiconductor
Drain
Gate
Flexible Substrate
P_r
Stress
-26.4
-26.2
-26.0
-25.8
P_r (mC/m^2)
0.0
-0.2
-0.4
-0.6
σ_3 (N/mm^2)
0
10
20
30
40
50
60
70
80
Time (min.)