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Precise pressure sensor using piezoelectric nanocomposites integrated directly in organic field-effect transistors

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With recent advances in flexible and stretchable electronics, the development of physically responsive field-effect transistors (physi-FETs) that are easily integrated with transformable substrates may enable the omnipresence of physical sensing devices in electronic gadgets. However, physical stimuli typically induce whole sensing physi-FET devices under global influences that also cause changes in the parameters of FET transducers, such as channel mobility and dielectric capacitance that prevent proper interpretations of response in sensing materials. Extended-gate structures with isolated stimuli have been used recently in physi-FETs to demonstrate performances of sensing materials only. However, such approaches are limited to prototype researches since isolated stimuli rarely occur in real-life applications. In this report, we theoretically and experimentally demonstrated that integrating piezoelectric nanocomposites directly into flexible organic FETs (OFETs) as gate dielectrics provides a general research direction to physi-FETs with a simple device structure and the capability of precisely investigating functional materials. Measurements with static stimulations, which cannot be performed in conventional systems, exhibited giant-positive d33 values of nanocomposites of barium titanate (BT) NPs and poly (vinylidene fluoride-trifluoroethylene) (P(VDF-TrFE)).

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