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산화아연 압전 나노전력발전소자 기반 에너지 하베스팅

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Nanopiezotronics is an emerging area of nanotechnology with a variety of applications that include piezoelectric field-effect transistors and diodes, self-powered nanogenerators and biosystems, and wireless nano/biosensors. By exploiting coupled piezoelectric and semiconducting characteristics, it is possible for nanowires, nanobelts, or nanorods to generate rectifying current and potential under external mechanical energies such as body movement (handling, winding, pushing, and bending) and muscle stretching, vibrations (acoustic and ultrasonic waves), and hydraulic forces (body fluid and blood flow). Fully transparent, flexible (TF) nanogenerators that are operated by external mechanical forces will be presented. By controlling the density of the seed layer for ZnO nanorod growth, transparent ZnO nanorod arrays were grown on ITO/PES films, and a TF conductive electrode was stacked on the ZnO nanorods. The resulting integrated TF nanodevice (having transparency exceeding 70 %) generated a noticeable current when it was pushed by application of an external load. The output current density was clearly dependent on the force applied. Furthermore, the output current density depended strongly on the morphology and the work function of the top electrode. ZnO nanorod-based nanogenerators with a PdAu, ITO, CNT, and graphene top electrodes gave output current densities of approximately 1-10 uA/cm^2 at a load of 0.9 kgf. Our results suggest that our TF nanogenerators are suitable for self-powered TF device applications such as flexible self-powered touch sensors, wearable artificial skins, fully rollable display mobile devices, and battery supplements for wearable cellular phones.