Electronic Supplementary Material (ESI) for Nanoscale.

Enhancement of Patterned Triboelectric Output Performance by Interfacial polymer Layer for Energy Harvesting Application

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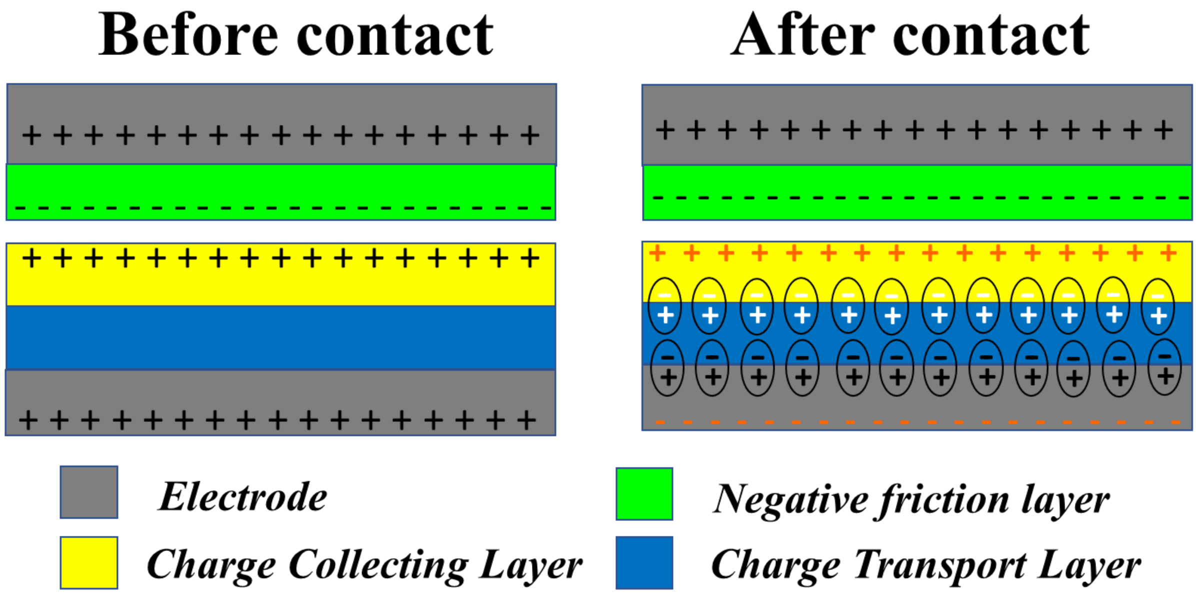
Charge transport mechanism for multilayer TENG:

In this work, initially we investigated triboelectric performance with the PTFE and LP PET. The basic TENG mechanism is based on the coupled effect of contact electrification and electrostatic induction and shown in Fig. S2. When the force is imposed on top of the device, both dielectric layers contact each other and oppositely charge surfaces are created. When the external force is withdrawn from the device, the potential drop created between them. However, some electron trapped in the shallow site of the LP PET layer drives to the electrode. The surface charge density was reduced due to merging positive charge to the electrode. On the other hand, the PTFE and PET belong to the tribo-negative materials category [1]. So, the same property material may not provide superior performance due to the screening effect. Thus, in order to improve the TENG performance, we introduced a multilayer composite structure which boosted the TENG output. The multilayer TENG consists of a charge collection layer (CCL), charge transport layer (CTL), and electrode. Here, the PEO is considered as a CCL and LP PET is CTL. The reason for selecting a CTL will improve the interfacial area and increase the charge density between CCL and CTL [2]. The function of CCL layer is to collect charges from the opposite frictional layer and CTL helps to trap the charges in deep and reduce the obstruction to new charges entering the system by transferring them. In the multilayer TENG mechanism, Due to contact electrification the positive surface charges are generated on the CCL surface and induce negative charges beneath the positive tribo-material. These negative charges attract the positive charges from the top of CTL. Therefore, the electrons are trapped deep in the sites by CTL and conserved for a longer time. Because the CTL (LP PET) has large charge trap densities compared to CCL(PEO). This causes the surface potential to rapidly saturate, increasing the potential difference between electrodes. Hence, the interfacial layer significantly contributes to enriching the surface charge density and accumulation, resulting in improved TENG performance.



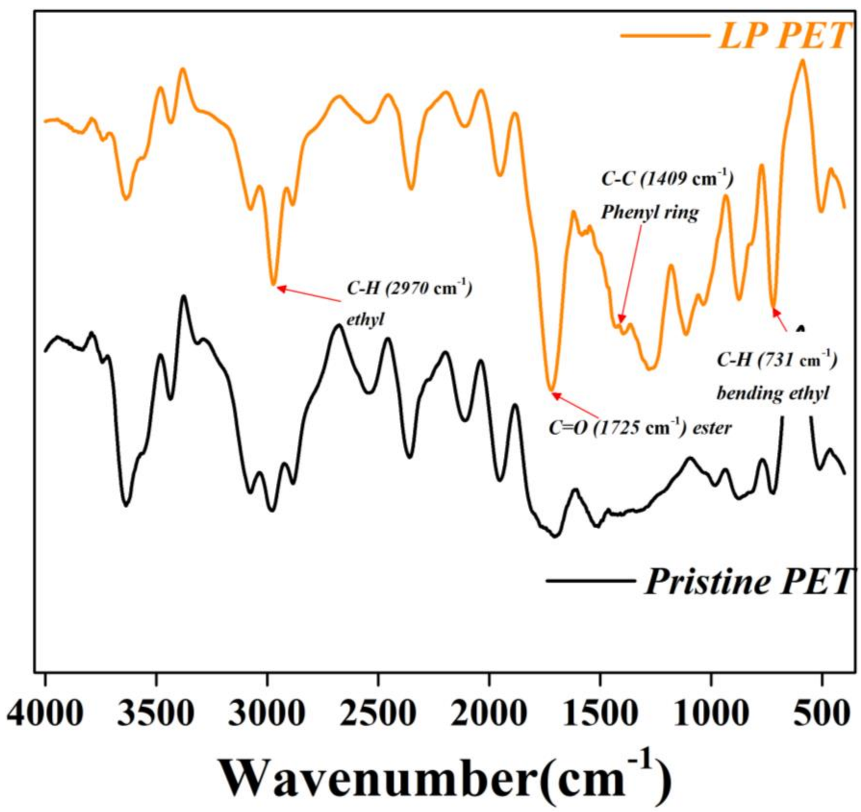


Fig. S1 FTIR transmittance spectrum of pristine PET and laser patterned PET substrate

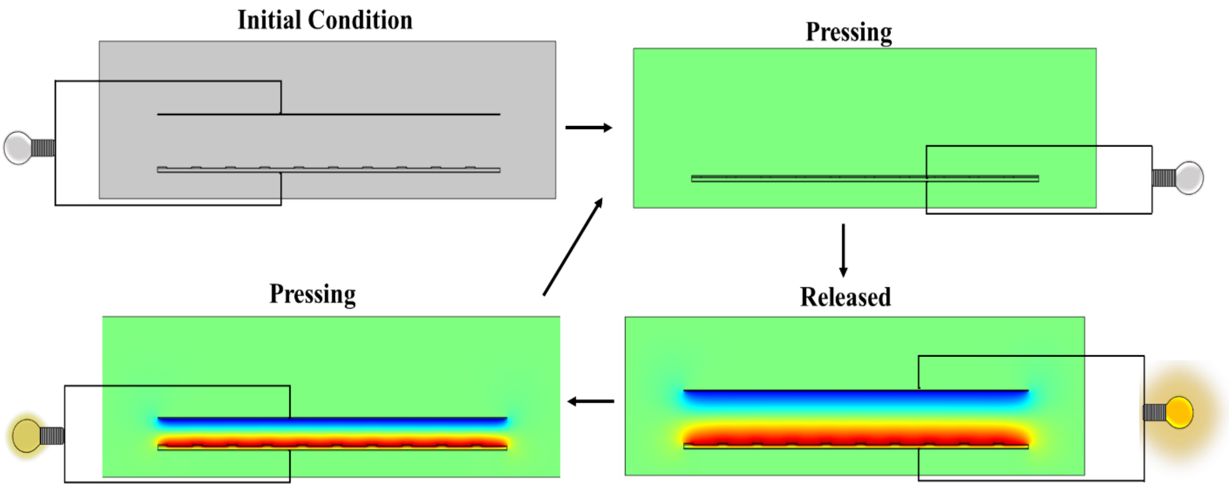


Fig. S2 COMSOL simulation with contact and separation mechanism

Table 1: Bands associated with LP PET from FTIR and Raman

Wave number(cm-1)			**Band configuration**
Raman	LP PET	1726 cm^{-1}	carboxylic acid group and C=O
	PEO	1479, 1281 cm^{-1}	CH_2 group
FTIR	LP PET	2970 cm^{-1}	C–H ethyl
		1725 cm^{-1}	C=O ester
		1409 cm^{-1}	C–C Phenyl ring
		731 cm^{-1}	C–H bending ethyl

Table S2 Cumulative results of this work and previous work

Device	**Short circuit current (peak to peak) (μA)**	**Open circuit voltage (peak to peak) (V)**	**Power density (μW/cm^2)**
Previous report	35.7	0.46	0.8
Pristine	42.65	0.485	-
DL_1	99.76	1.25	-
DL_2	131.85	2.327	41.6