Smart wearable Kevlar-based safe-guarding electronic textile with excellent sensing performance

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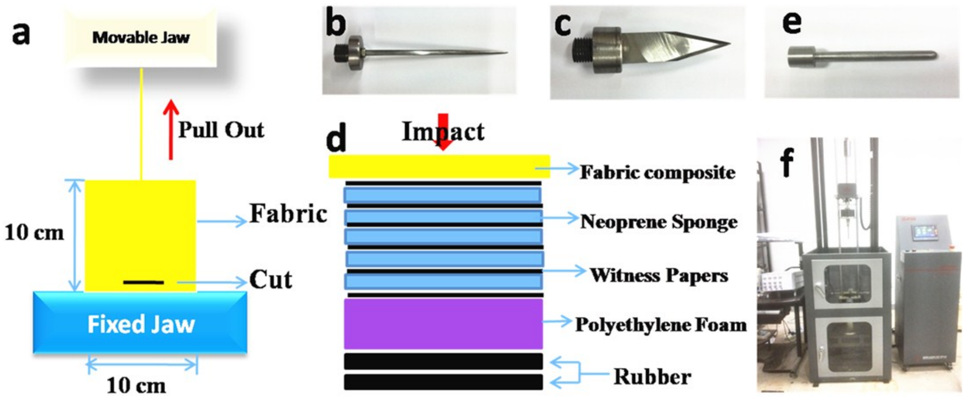

Figure S1 Schematic of yarn pull-out test setup (a); drop mass weapon used for the dynamic impact test: spike (b), knife (c) and blunt impactor (e); Stab resistance testing fabrics and foam backing (d); the drop hammer test device (f).

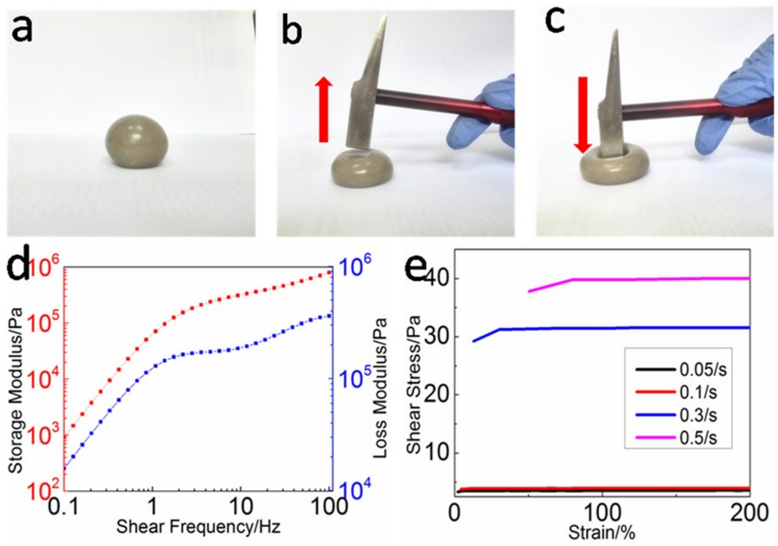

Figure S2 Rate-dependent mechanical properties of the S-ST polymer with different external excitation: pristine sample (a); small changes in dimensions if impacted violently (b); flexible and plastic if compressed slowly (c-d). Storage modulus (*G′*) and loss modulus (*G″*) (e) of S-ST polymer in the shear frequency tests; Stress-strain curves (f) and loops (g) of S-ST polymer sample under the excitation of different shear rates.

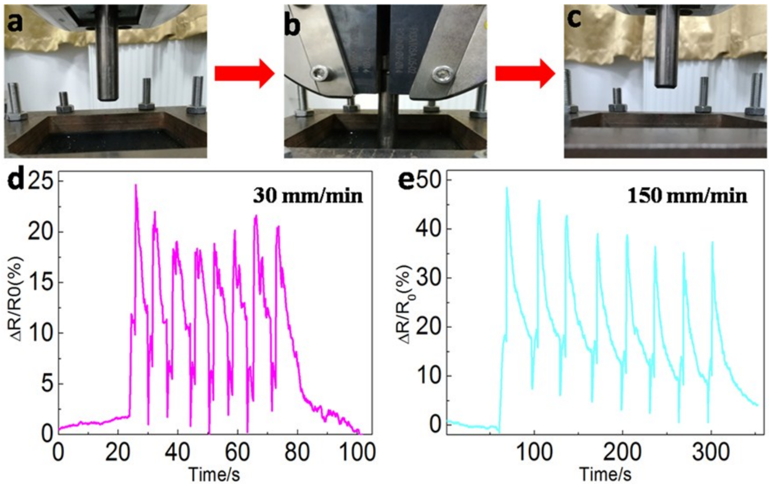

Figure S3 Static compression testing devices (a-c) and cyclic stability of WET with compression rates at 30 (d) and 150 mm/min (e).

The cyclic compression tests with compression rates at 30 and 150 mm/min were conducted by the blunt impactor fixed on MTS and the results were shown in Fig.S3. Clearly, WET exhibited ideal stimuli-responsive sensing properties. When the compression rate was 30 mm/min, the maximum changes in resistance were about 20%. (Fig.S3d) Since higher compression rate could lead to serious deformation of ECPs in short times, the resistance variations reached to about 40% when the rate was 150 mm/min. (Fig.S3e) Based on the results above, WET exhibited excellent sensing properties under the repeated constant compressions.

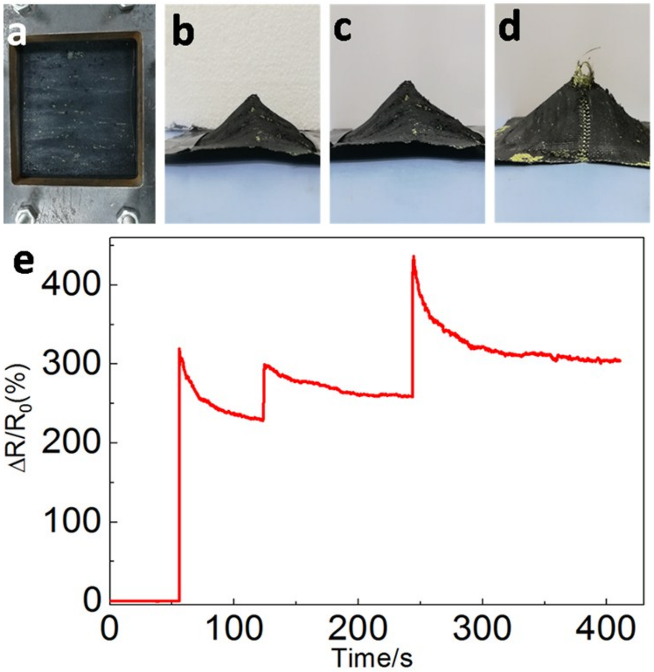

Figure S4 Cyclic impact testing devices and the WET (a-d); Stimulus-responsive sensing performance of WET under repeated impact stimuli (e).

On the other hand, as for body armor materials, it was very essential to totally destroy them to precisely assess their maximum safeguarding performance. So we re-conducted the dynamic repeating impact resistance tests by the blunt impactor falling from 30 cm and the sensing properties were shown in Fig.S4. Undoubtedly, the resistance of WET was dramatically increased once impacted which showed ideal sensing property. Moreover, the maximum variation in resistance induced by the second impact was lower than the first one, this was because of the smaller shape change of WET during the second impact. However, maximum variation in resistance appeared once WET was totally pierced. This was due to the serious destruction in effective conductive path (ECP). Overall, the stimuli to WET were absolutely different from those loaded on traditional sensors. The violent impacts by these impactors always pierced WET seriously and formed irreversible ruin to ECP. Because the WET would be destroyed during the constant violent impacts, the stimulus-responsive sensing properties under the repeated constant impact stimuli were not very ideal during the impact force sensing tests.