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**Supplementary information:** 



**Fig. S1** Electrical resistivity strain dependency of: a) POE/TPU-CNT 70/30-6, b) POE/TPU-CNT 30/70-6, c) POE/TPU-CNT 50/50-6; from different post-processing procedure: as-prepared, pre-stretched between 40-80% strain, pre-stretched between 120-180% strain, pre-stretched between 200-240% strain.



Fig. S2 Pre-stretched POE/TPU-CNT 70/30-6 blends between 120-160% strain.



Fig. S3 Pre-stretched POE/TPU-CNT 70/30-6 blends between 120-160% strain under 200% strain.



Fig. S4 Pre-stretched POE/TPU-CNT 30/70-6 blends between 120-160% strain.



Fig. S5 Pre-stretched POE/TPU-CNT 30/70-6 blends between 120-160% strain under 200% strain.



Fig. S6 The DMA test for those blends. The storage modulus of these materials at 20 °C are used to calculate the effect modulus of TPU-CNT phase in different blends according to rule of mixture.