Influence of Functionalized Core-shell Structure on the Thermodynamic and Shape Memory Properties of Nanocomposite

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Supporting Information

The tensile mode was used to test the stress recovery, and a tensile tester (Instron 4501) anchored with temperature chamber was adopted. The tensile load was measured using a load cell and the displacement of the gauge length was measured from the displacement of a cross-head. The heating rate was kept constant (5℃/min) while the cooling was done at ambient temperature. The sample was cut into film strips (80 mm×10 mm×0.4 mm) for the testing. The schematic diagram of stress-time profile during programming and recovery process and the result of stress recovery test are as shown in the Fig. S1.

In the Fig. S1(a), Programming is a process of storing stress, also termed as charging the shape memory polymer. The critical part is to eliminate another impeditive component that is viscous stress, and prepare the material to retrieve or freeze the stress at diversified magnitudes and levels upon controlled triggering. A programming cycle includes three steps after heating the original relaxed specimen to 70℃ ($T_h > T_{trans}$). In step 1 (S1→S2), the specimen is stretched to a 100% strain level (S2); in step 2 (S2→S3), the specimen is held under constraint to relax the stress to a saturation level (S3), where the viscous stress is eliminated; in step 3 (S3→S4), the specimen is cooled under constraint to lower temperature (S4), where the temperature is 30℃ ($T_l < T_{trans}$) for the charging/storing of the

stress in the polymer network. No residual stress was observed up to 100% strain after cooling. After programming the TPI memory polymer, it is ready to perform stress memory test, which is step 4 (S4→S5) in Fig. S1a. Once the programmed stress is stored, the shape memory polymer was discharged at high temperature under constraint to obtain the recovery stress. The temperature for discharging the stress was ranging from 30℃ to 70℃. Then, we can obtain the Recovery Stress-Temperature curves, as shown in Figure S1(b). Furthermore, based on Figure S1(b), we can get the maximum recovery stress of test samples, as shown in Figure S1(c).

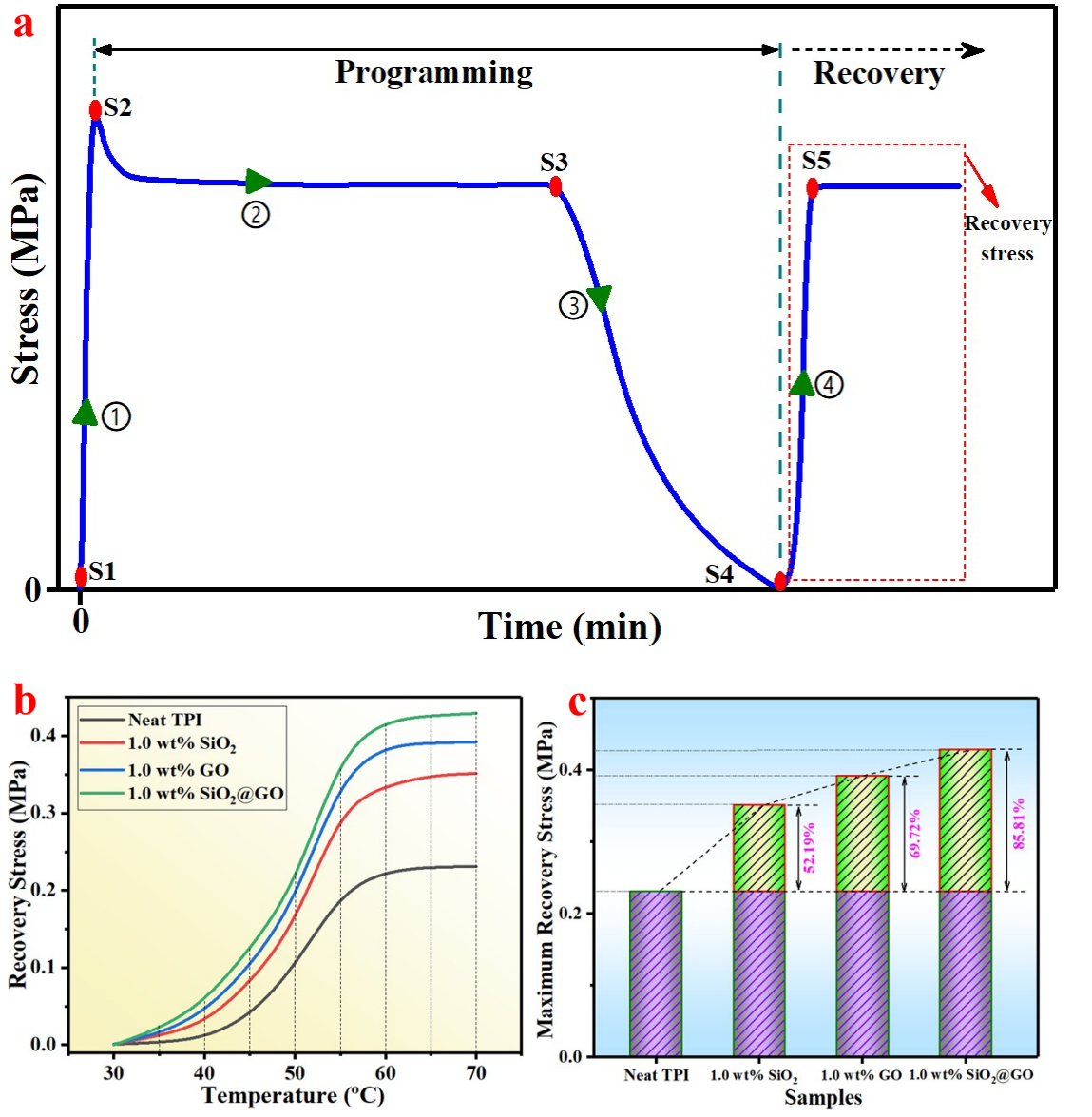

Fig. S1. (a) The schematic diagram of stress-time profile during programming and recovery process, (b) recovery stress at different temperature levels during discharging and (c) maximum recovery stress of sample with different filler.