

Supporting Information

Enhancement of Mechanical Stability in Hydrogen-bonded Photomobile Materials with Chemically Modified Single-walled Carbon Nanotubes

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Materials and experimental setup

The molecular weight of polymers was determined by gel permeation chromatography (GPC; Japan Spectroscopy Co., DG-980-50; column, Shodex LF804 + LF804 + LF804A; eluent, tetrahydrofuran (THF)) with polystyrene standards used for calibration. A complex of the copolymer and the crosslinker (PAAC-P) was prepared from a THF solution containing equimolar amounts of the carboxy group and pyridine moiety. The mesomorphic properties of the copolymer and the complex were evaluated by differential scanning calorimetry (DSC; SII, DSC6220G) with heating and cooling rates of 10 °C/min. P-SWNTs prepared by high pressure CO (HiPCO) synthesis were purchased from Carbon Nanotechnologies, Inc. Chemical modification of the P-SWNTs was conducted according to the literature.⁹ For purification, the P-SWNTs were thermally oxidized at 230 °C for 18 h to remove residual amorphous carbon and subsequently stirred in 2 mol/L HCl to remove metal impurities. Purified SWNTs were obtained by filtration and drying under reduced pressure for 12 h. The purified SWNTs were then oxidized by sonication in a H₂SO₄/HNO₃ mixture (3:1) for 1 h, followed by dilution and washing with water. Chemical modification of the SWNTs was confirmed by Raman spectroscopy (Jasco, NRS-2100), IR spectroscopy (Jasco, FT/IR-610), and X-ray photoelectron spectroscopy (XPS; Shimadzu, ESCA-3400 for chemical analysis). UV-vis absorption spectra of the polymer were measured using a Jasco V-550 spectrometer. Optical anisotropy of the composite fiber and dispersive properties of the SWNTs were characterized with a polarizing optical microscope (Olympus, BX50). Photoinduced macroscopic deformation was observed by irradiation with UV light at 365 nm from a UV-LED (Keyence, UV-400 with UV-50H and L-8) instrument and recorded with a digital video camera (Omron, VC-1000 and VC-HRM20Z). After measurement, the bent film was exposed to visible light from a 530 nm LED irradiator (CCS, PJ-1505-2CA with HLV-24GR-3W) to revert to the initial shape. The tensile stress and the mechanical force generated by photoirradiation of the fibers were measured with a thermomechanical analyzer (Shimadzu, TMA-60).

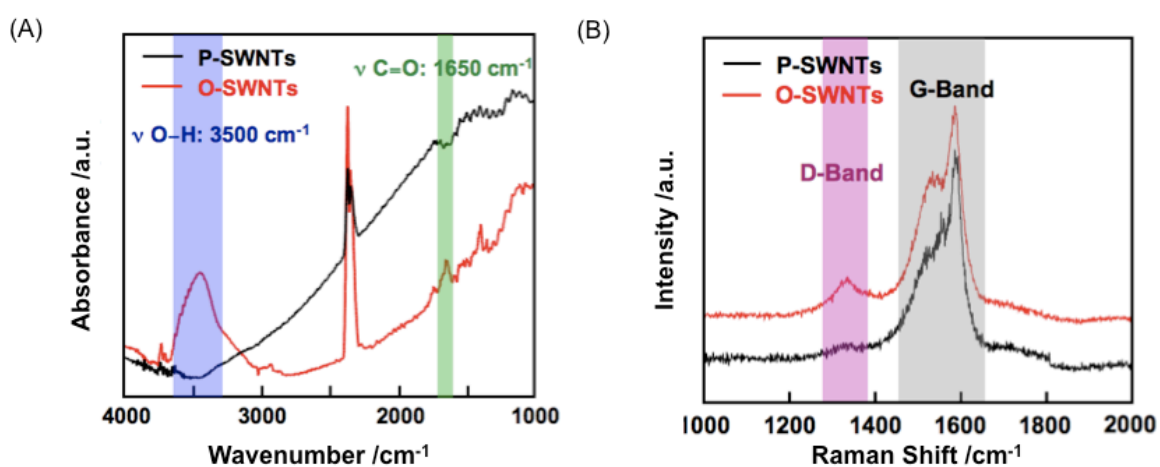


Figure S1. (A) IR and (B) Raman spectra of SWNTs before and after chemical modification.

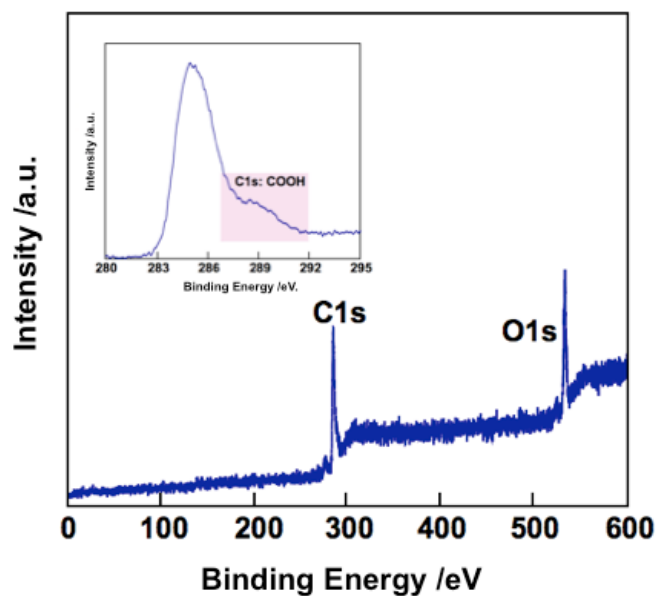


Figure S2. XPS spectrum of O-SWNT. The inset shows the magnified spectrum for the C 1s region.

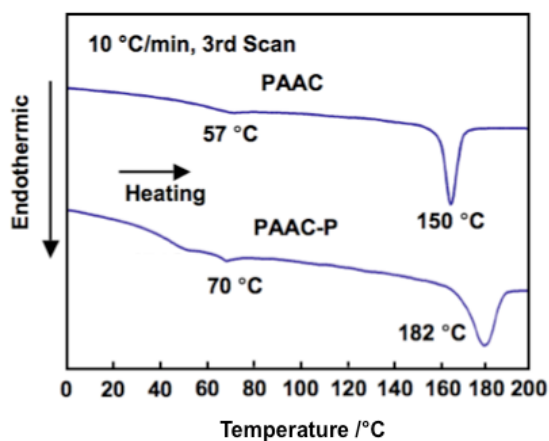


Figure S3. DSC thermograms of the copolymer (PAAC) and the complex with PEAP (PAAC-P) on heating.

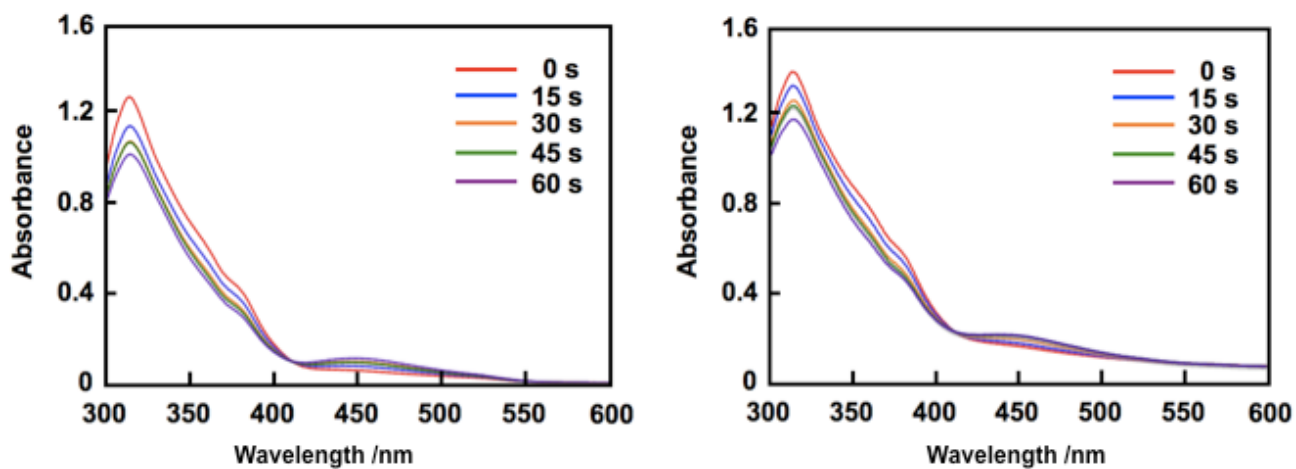


Figure S4. UV-vis absorption spectra of PAAC-P (left) and P/OS-0.1 (right) in DMF upon irradiation at 366 nm.

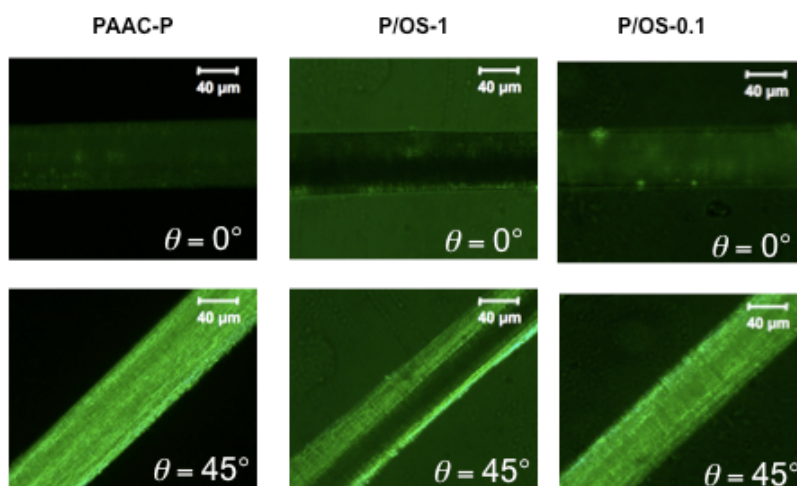


Figure S5. Polarizing optical microscopy images of the texture of the fibers.

The dark region in a figure for P/OS-1 (Fig. S5, second row, middle) is most probably due to an isotropic defect produced during drawing the fiber.

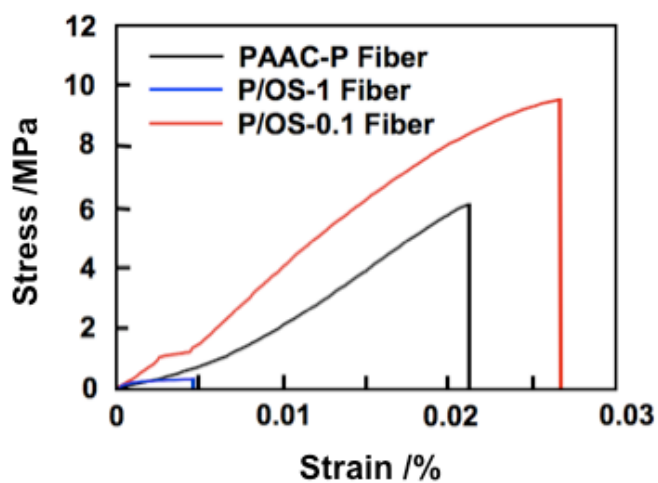


Figure S6. Stress-strain curves of the composite fibers at room temperature (loading rate = 50 mN min⁻¹).