Electronic supplementary information (ESI)

Polyethylene Oxide Enhanced Ductility and Toughness of Polylactic Acid: the Role of Mesophase

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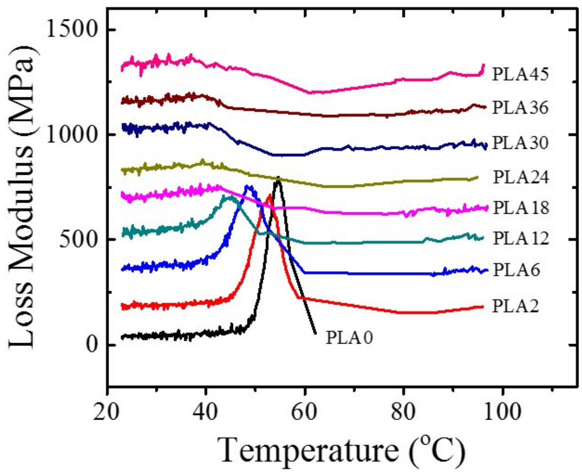

Fig. S1 Temperature dependence of loss modulus of WQ-films (30×5×0.2 mm^3, length × width × thickness) measured by DMA. The curves are intentionally shifted along the loss modulus axis for the sake of clarity. Experiments were carried out on a Q800 apparatus from TA Instrument (USA) in the multifrequency strain mode with a frequency of 1 Hz. The temperature covers a range of 20-100 °C at a heating rate of 3 °C/min. The peak of loss modulus is interpreted as $T_{g\text{-}PLA}$, which presents a decrease from around 56 °C for PLA0 to 39 °C for PLA45 with increasing PEO content. The DMA measurement gives a consistent result with that of DSC.

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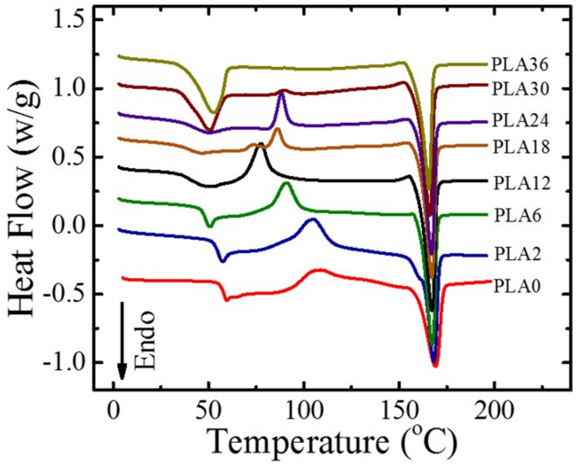

Fig. S2 DSC curves of SC-films in the heating process from 0 to 200 °C at a rate of 10 °C/min. The curves are intentionally shifted along the heat flow axis for the sake of clarity. The $T_{g\text{-}PLA}$ of SC-films presents a similar evolution trend to that of WQ-films.

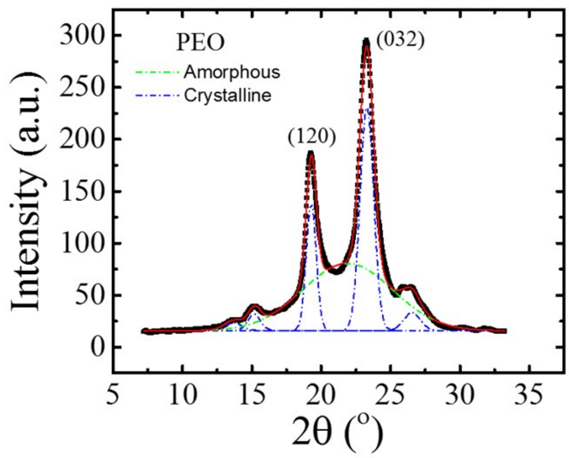

Fig. S3 Typical 1D WAXD intensity curve of pure PEO that is crystallized. The diffraction peak of amorphous phase is located at 2θ of 21.7°, close to that of 21.5 ° of amorphous PLA.

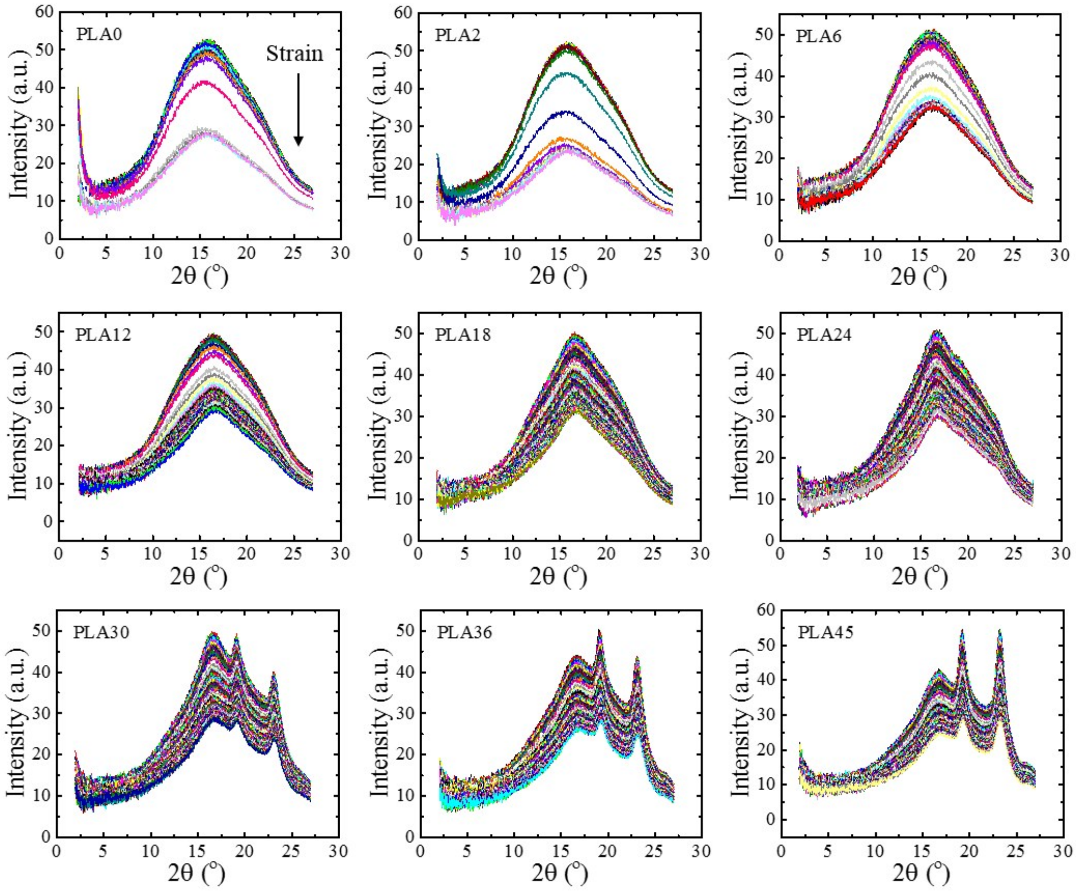

Fig. S4 1D WAXD intensity curves of WQ-films under tensile deformation. The arrow denotes the direction of strain increase.

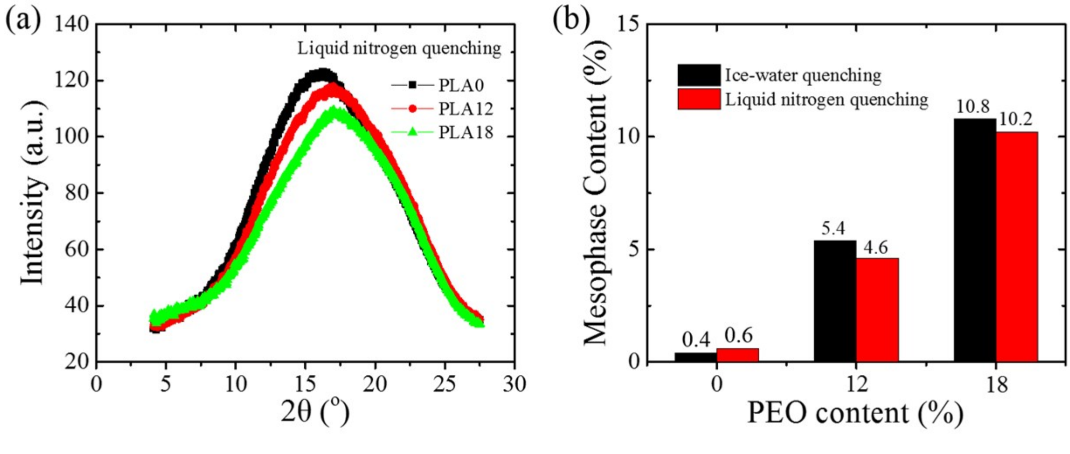

Fig. S5 (a) 1D WAXD intensity curves of PLA0, 12 and 18 films prepared by liquid nitrogen quenching from 200 to -196 ^{o}C. (b) Comparison of the mesophase content in PLA/PEO composite films prepared by liquid nitrogen quenching with that by ice-water quenching. It can be found that only a very limited decrease of mesophase content occurs if ice-water is replaced by liquid nitrogen. This means that the melt quenching induced formation of PLA mesophase exists in a large cooling rate window.

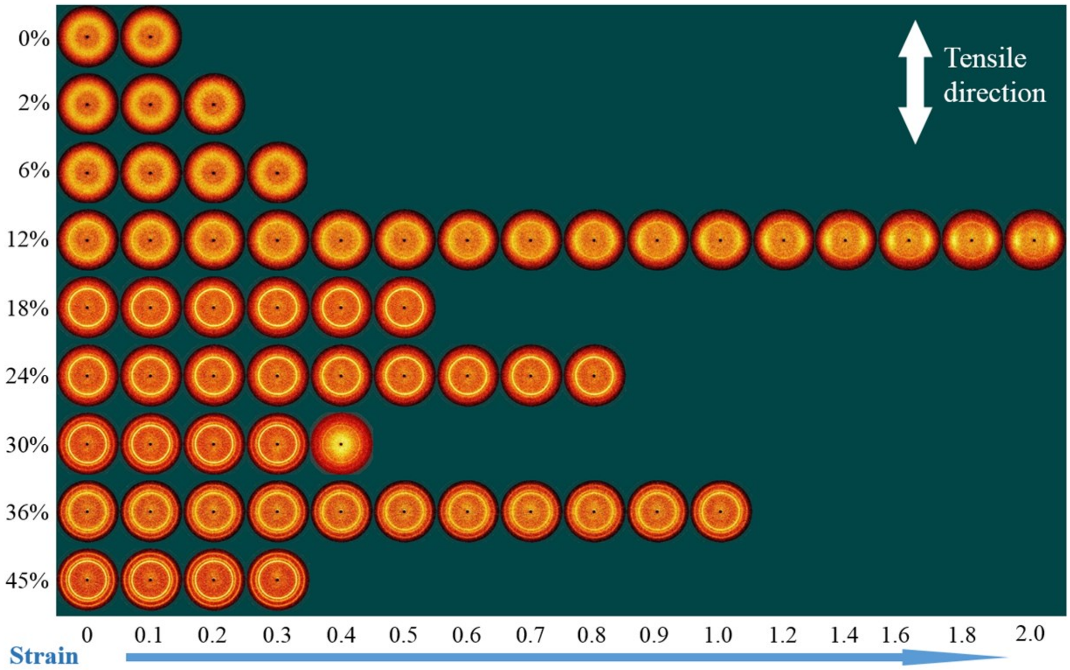

Fig. S6 Selected 2D WAXD patterns of SC-films as a function of strain under deformation. The deformational direction is vertical.

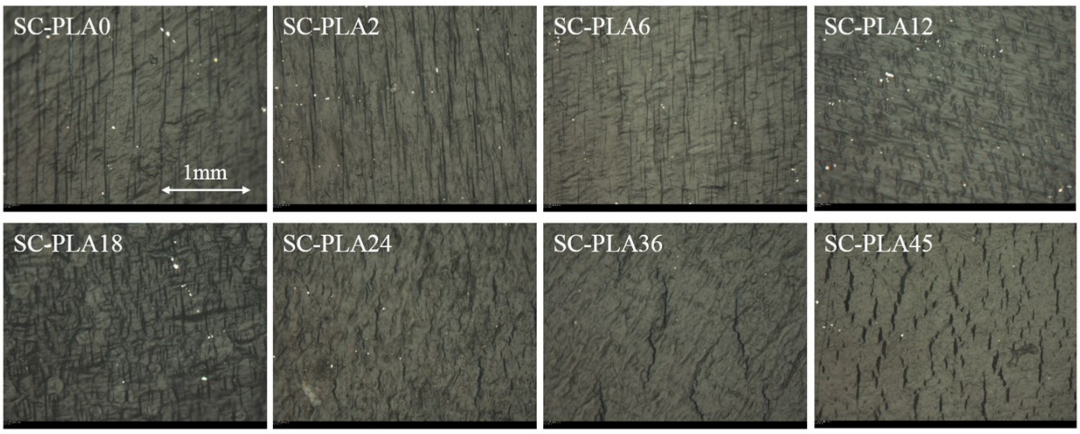

Fig. S7 POM micrographs of the surface topography close to the fracture edge of SC-films after tensile deformation.