

Supporting Information

Protein-based Soft Actuator with High Photo-Response and Easy Modulation for Anisotropic Cell Alignment and Proliferation in Liquid Environment

Min-Yu Chiang, Yu-Chih Lo, Yen-Han Lai, Yu-Yan Au Yong, Shwu-Jen Chang, Wen-Liang Chen, and San-Yuan Chen

The ELP polypeptide sequence design and expression process are shown in **Figure S1**. The backbone structure of the ELPs is a repeating sequence of VPGIG found in the mammalian elastic protein, which confers enhanced mechanical properties similar to nature elastin, superior biocompatibility, and a stimuli-responsive nature. Furthermore, a tripeptide RGD sequence, which is the sequence in fibronectin that mediates cell attachment, was inserted in the backbone structure of the ELP. There are several sites of isoleucine replaced by lysine because the ϵ -amino groups of lysine can be considered for cross-linking and other chemical modifications while retaining the properties of ELPs. To express ELP polypeptide, the gene sequence of ELP was first cloned into expression the vector, pET28a(+), which contains His Tag for purification of ELP by nickel column. The pET28a(+) vector was transformed into E.coli BL21 (DE3), cultured and expressed by isopropyl thio- β -D-galactoside (IPTG), a molecular biology reagent that induces synthesis of protein in E.coli. SDS-PAGE was used for separating proteins according to mass to demonstrate that the ELP of 39 kDa was successfully expressed and purified.

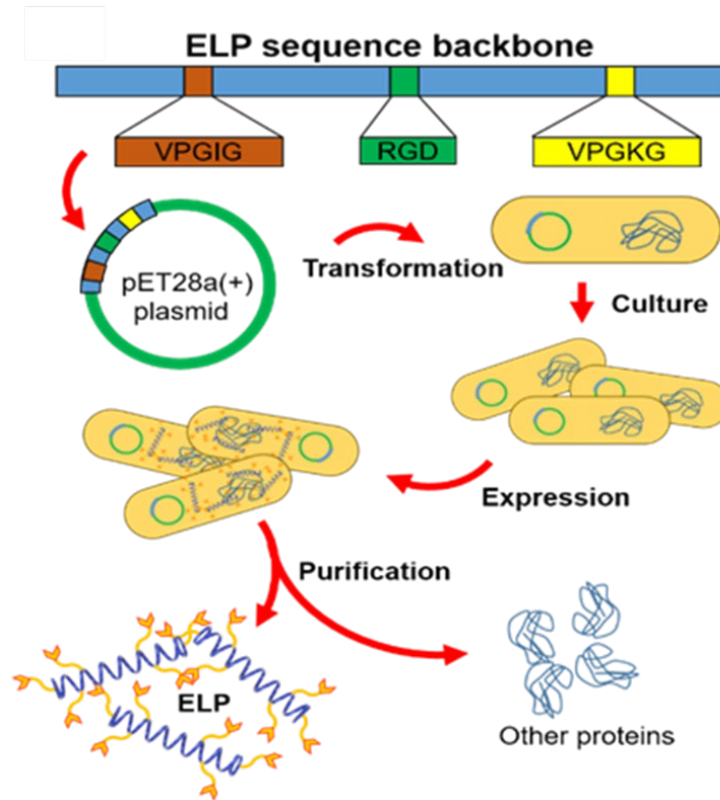


Figure S1. Schematic illustration of designed sequence and plasmid, steps of transformation, culture, expression and purification of elastin-like polypeptide (ELP).

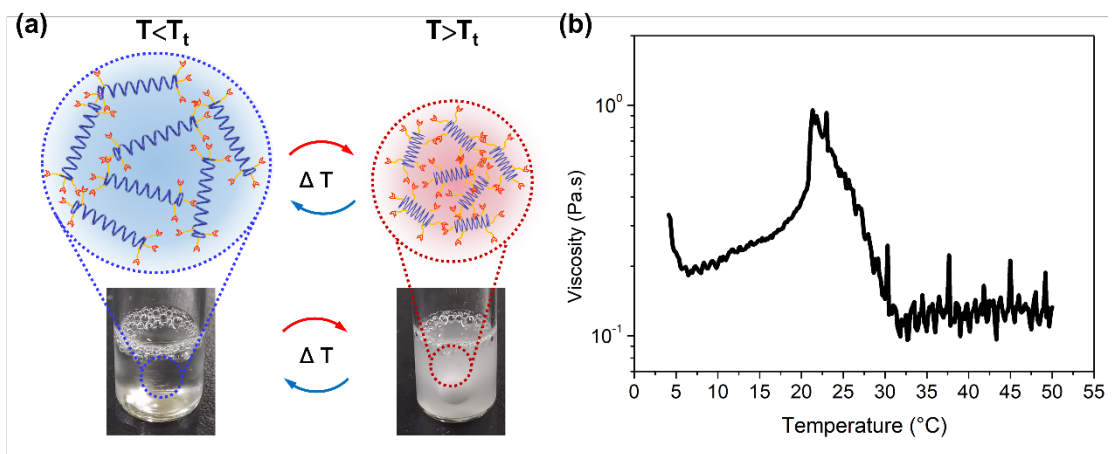


Figure S2. Expression and characterization of ELP.

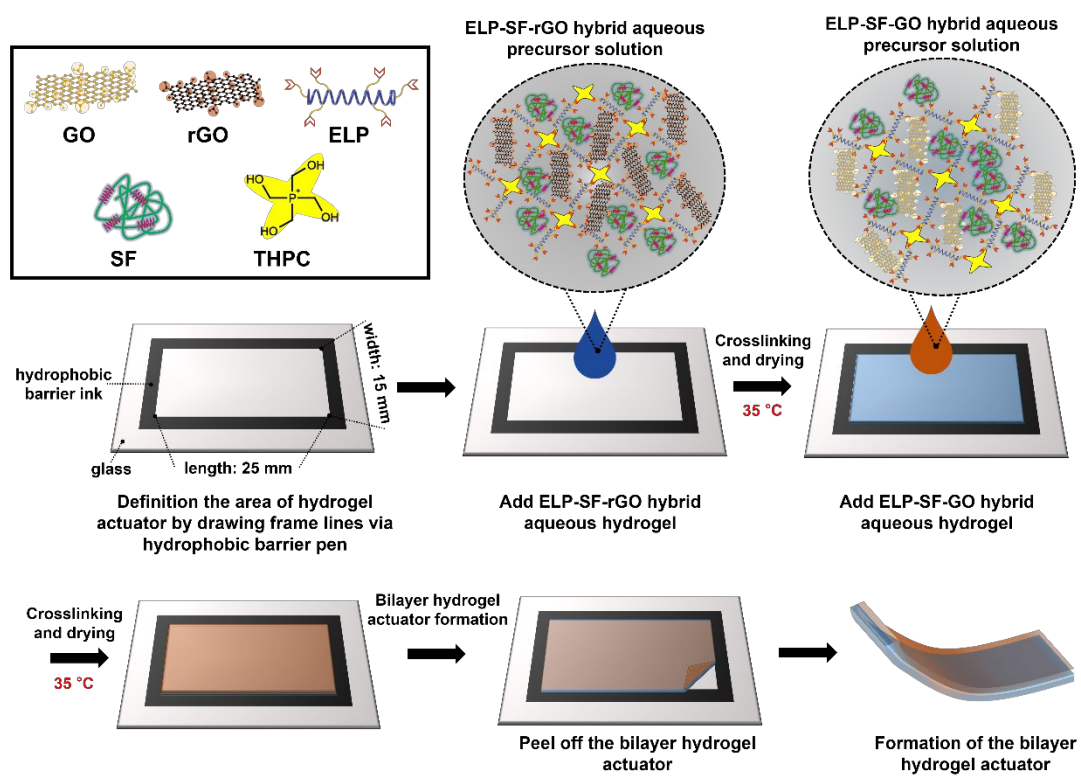


Figure S3. Fabrication process for bilayer hydrogel actuator.

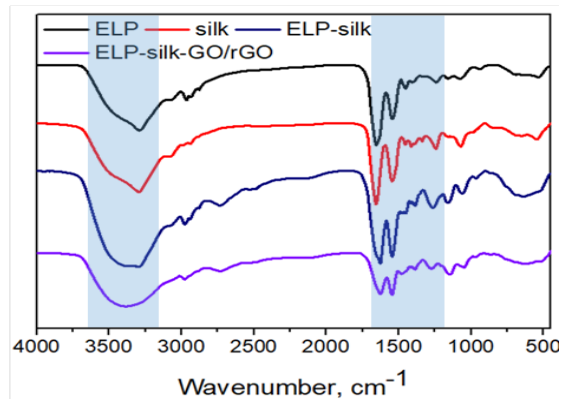


Figure S4. FTIR spectra of ELP (black line), silk (red line), ELP crosslinked with silk (blue line) and ELP-silk crosslinked with GO and rGO (purple line).

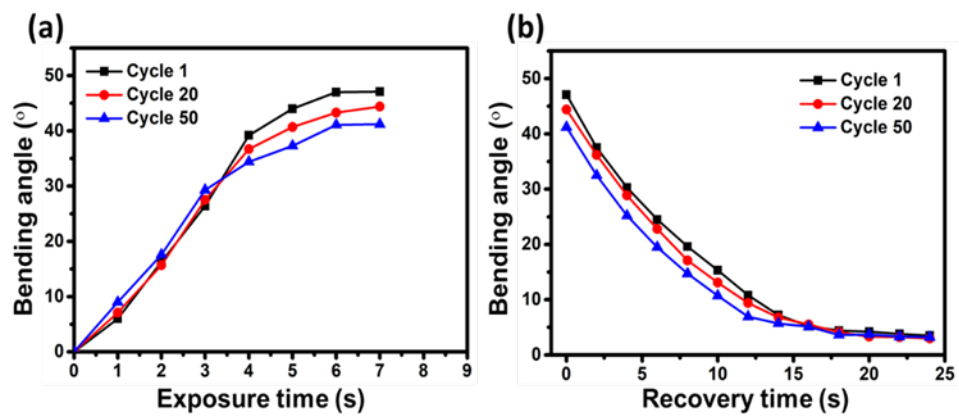


Figure S5. (a) Change in bending angle in response to repeated NIR laser exposure (1.2 W/cm^2). (b) Recovery of hydrogels after the NIR stimulation was removed. ($n=3$)