Supporting Information

Bacteria Inspired Soft Robots with Responsive Flagellar Bundles

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Calculation of ideal propulsion velocity of a flagellar soft robot
The calculation the propulsion velocity can be performed when combing Eqn. 3-4 in the main text and can be shown as:

$$\frac{V_z}{\omega} = (\xi_r + \xi_h)\mu_{tr} \tag{S1}$$

and the rotation friction coefficient for a helix and spinning disk (magnetic head) has been shown as Eqn. 2 and the main text and when substituted into Eqn. S1, and the final form can be shown as:

$$\frac{V_z}{\omega} = \frac{\left(\frac{32}{3}\eta_s {R_h}^3 + \frac{\pi\eta_s(2L)^3}{3[\ln{(L/a)} - 0.8]}\right)}{\eta_s a^2} f \tag{S2}$$

, where constant f can be deducted from Fig. 4B for configuration A3 as ~0.0008.

Eventually when substituting $R_h = 14.4$ mm, $a = 2$ mm, $L/a = 3.6$,$\omega = 4.19\ rad/s$,the final result for $V_z = 27.3$ mm/s.

Supplementary Figures

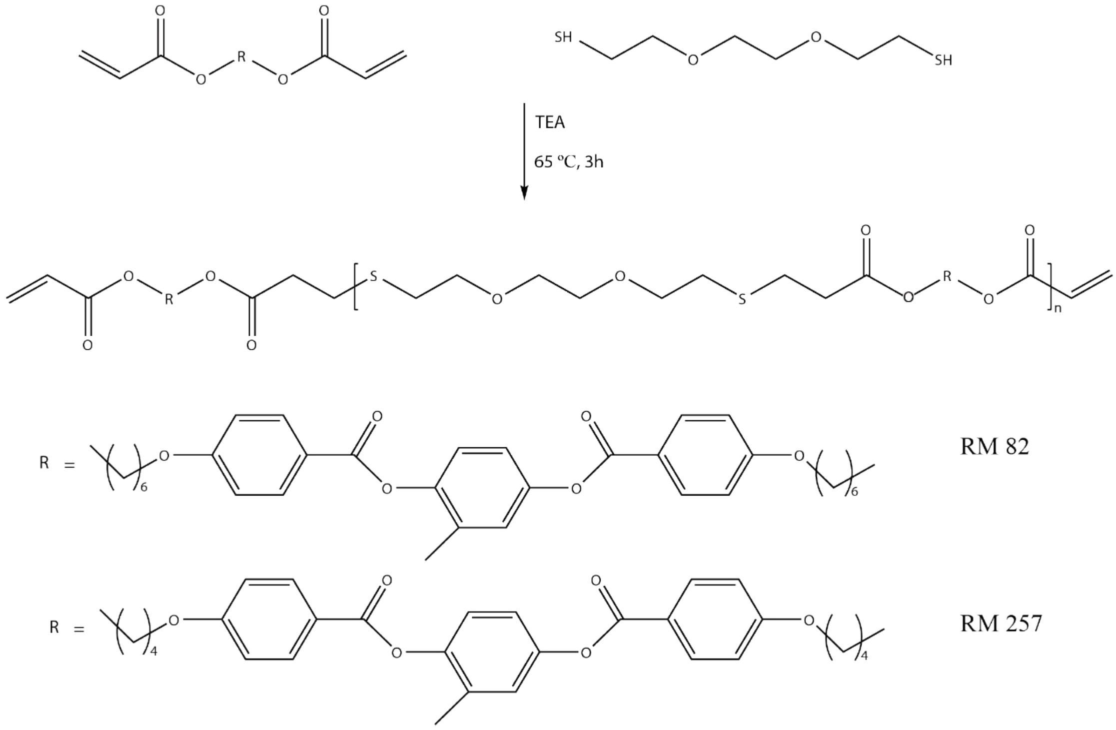


Fig. S1 Reaction scheme for LC monomer oligomerization.

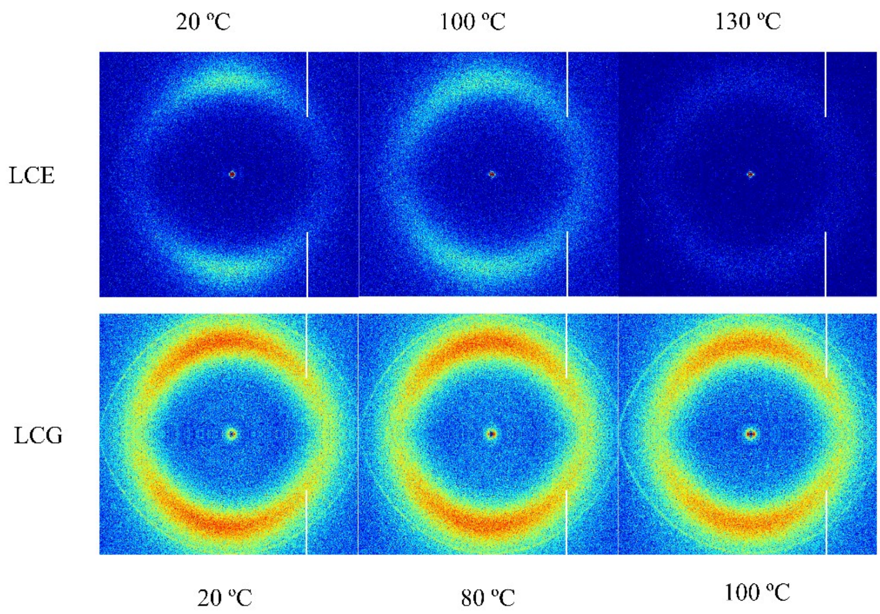


Fig. S2 2D WAXD pattern of printed LCE (above) and LCG (below) fibers at different temperatures.

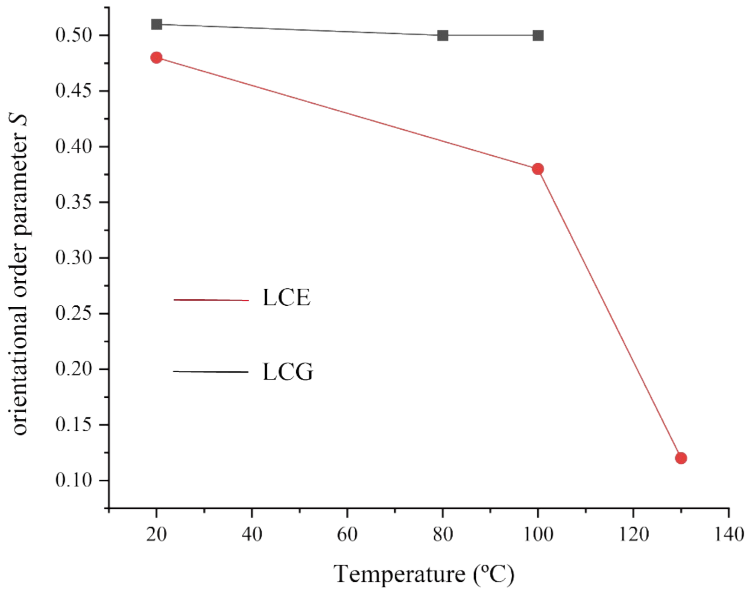


Fig. S3 Calculated orientational order parameters for printed LCE (red dots) and LCG (black squares) fibers at different temperatures.

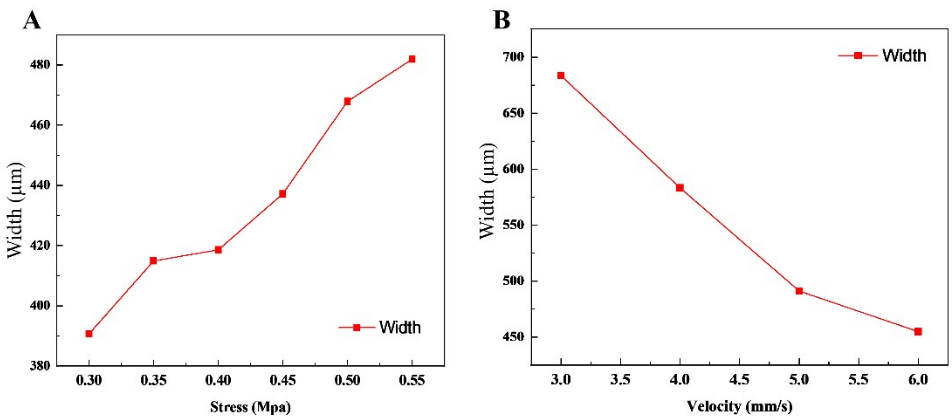


Fig. S4 Printing parameter on the printed filament thickness (A: air pressure; B: printing velocity).

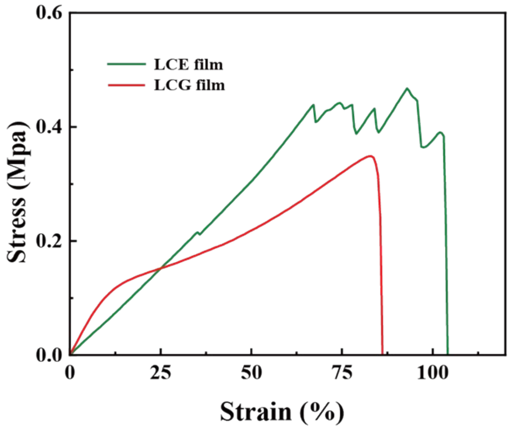


Fig. S5 Tensile curves for LCE/LCG films.

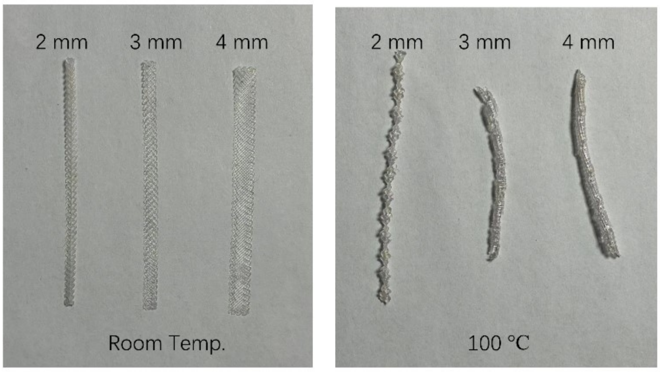
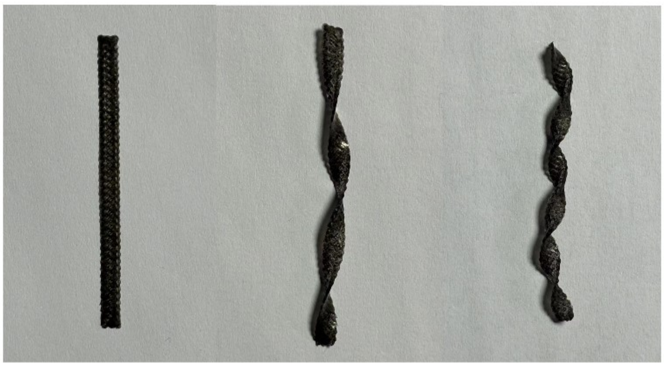


Fig. S6 Morphologies changes of LCE flagella with different widths when increasing the hot surface temperature from room temperature to 100 ºC. 2 mm: helicoid; 3 and 4 mm: twisted ribbons.



25°　　　50°　　　100°

Fig. S7 Morphologies changes of LCG flagella at different temperatures. Restricted twisting is observed compared LCE flagella in Fig. S6. The ribbon width is 4 mm.

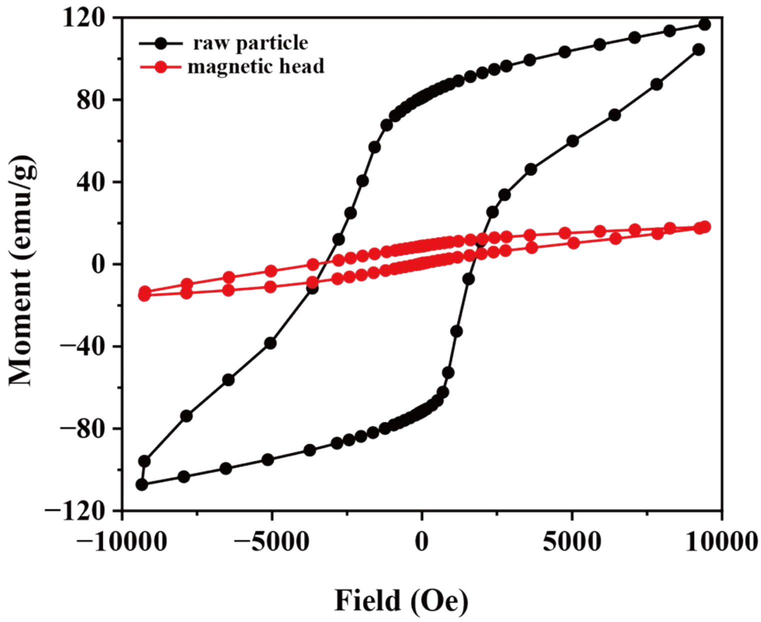


Fig. S8 Magnetization curves of raw magnetic microparticle powders and magnetic head composed of ~20 wt % microparticles.

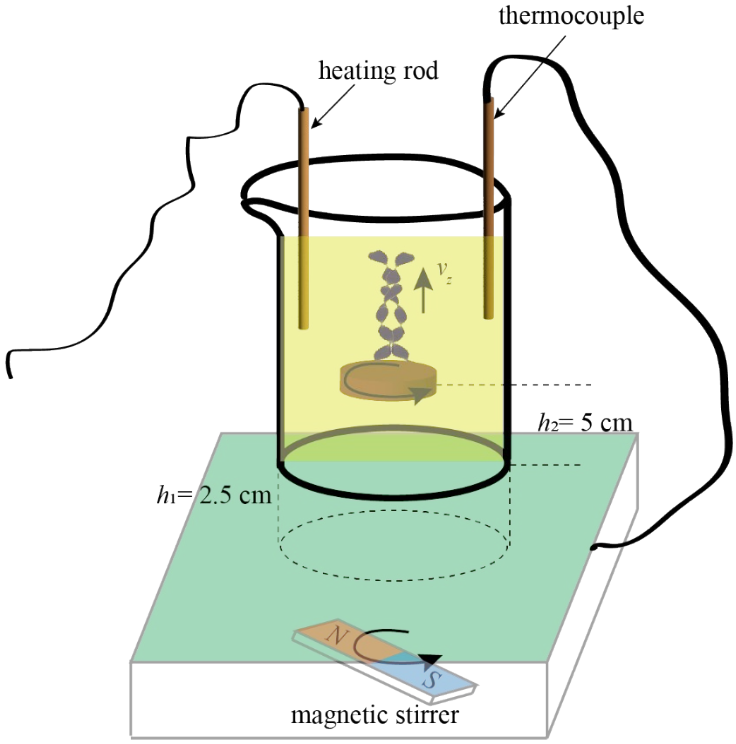


Fig. S9 Schematics of the experimental setup used for magnetic soft robot propulsion

Captions for Supplementary Movies

Movie S1 A right-handed LCE ribbon is curled into a left-handed helical structure when heated (Fig. 3E). The ribbon width is 4 mm. The movie is displayed at real speed.

Movie S2. Bundling between LCG spiral ribbons of a bi-flagellated soft robot (Fig. 5A). The rotation rate is 40 rpm. The ribbon width is 4 mm. The movie is displayed at real speed.

Movie S3 Unbundling process of bundled LCG flagella as the solution temperature is raised from room temperature to 50 °C while the rotation rate is kept at 40 rpm (Fig. 5B). The movie is accelerated 2x.

Movie S4 Comparison of "tumble" phase and "run" phase of a soft robot immersed in glycerol at 50 °C and 100 °C, respectively, while the rotation rate is kept at 40 rpm (Fig. 5D). The soft robot was initially put at the same levitation at the beginning. The movie is accelerated 2x.