Supplementary Information：

Bioinspired tilt-angle fabricated structure gradient fibers: micro-drops fast transport in a long-distance

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Content:

Supplementary Figure Legends: (Figs. S1-S5)

Figure S1:

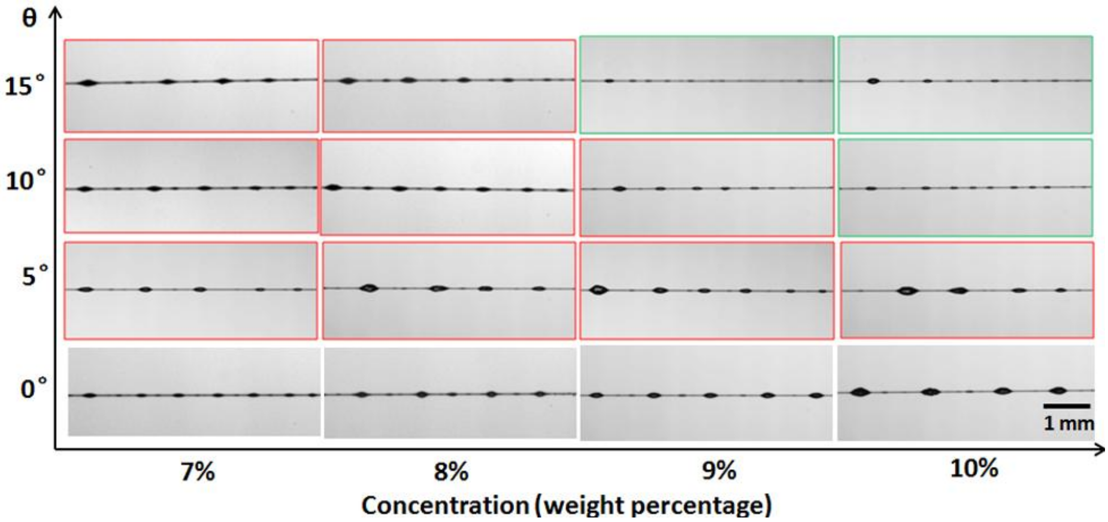

Figure S1 | Optical images of BFGS fabricated at different conditions by drawing the nylon fibers out of the PVDF/DMF solution. The concentration of the polymer solution is 7%, 8%, 9%, or 10%(weight percentage) and the angle to the horizontal line is 0°, 5°, 10°, or 15° with the same drawing-out velocity ~200 mm/min. In the green frame images, there are no obvious gradient structures on the spindle-knots. In the images with red frame, the obvious gradient spindle-knots appear. At 0° angle to the horizontal line condition, there are uniform spindle-knots. Under 5° and 8% or 9% condition, the bioinspired gradient fibers are the most suitable for water transport because of the height gradient and pitch of two spindle-knots. At high title angle, e.g., 15°, the largest pitch of two spindle-knots is more than 2 mm, which is not conducive to water transport. In our experiment, we choose the pitch close to 1.5 mm to observe the water transport.

Figure S2:

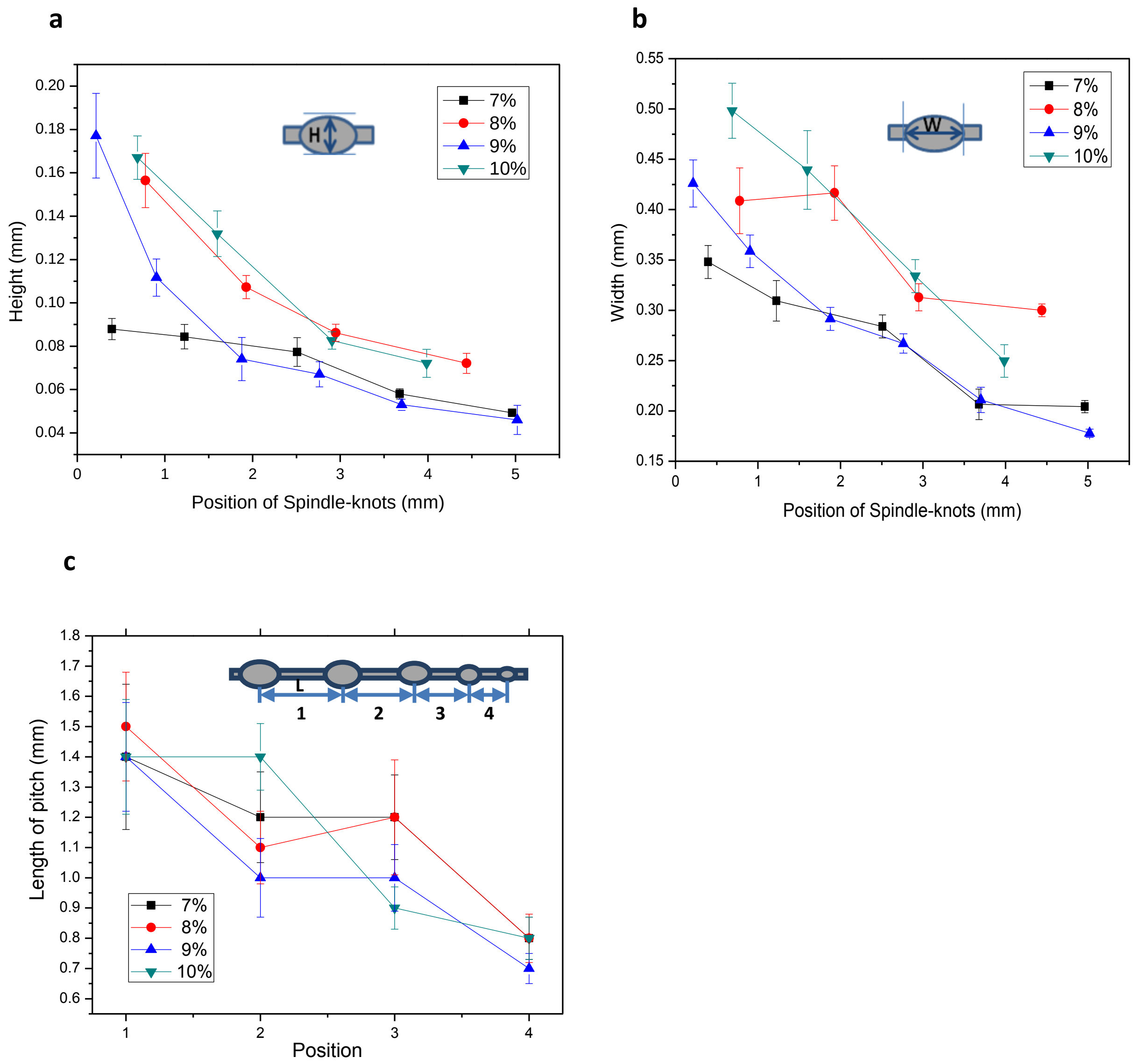

Figure S2 | The statistical data of the height (a), width (b) of the gradient spindle-knots respectively and four pitches of two spindle-knots (c) along the gradient fibers. At high concentration (10%), the slope rate is bigger than low concentration (7%) with height and width. At low concentration (7%), the height is from 0.09~0.05 mm, the width gradient from 0.35~0.21 mm, while the height and width range from 0.17~0.07 mm and 0.50~0.24 mm at high concentration (10%), respectively. However, the distance of two spindle-knots has no obvious difference with the concentration for the relative position. In our experiment, the most pitch is close to ~ 1.5 mm, which is suit for the water transport.

Figure S3:

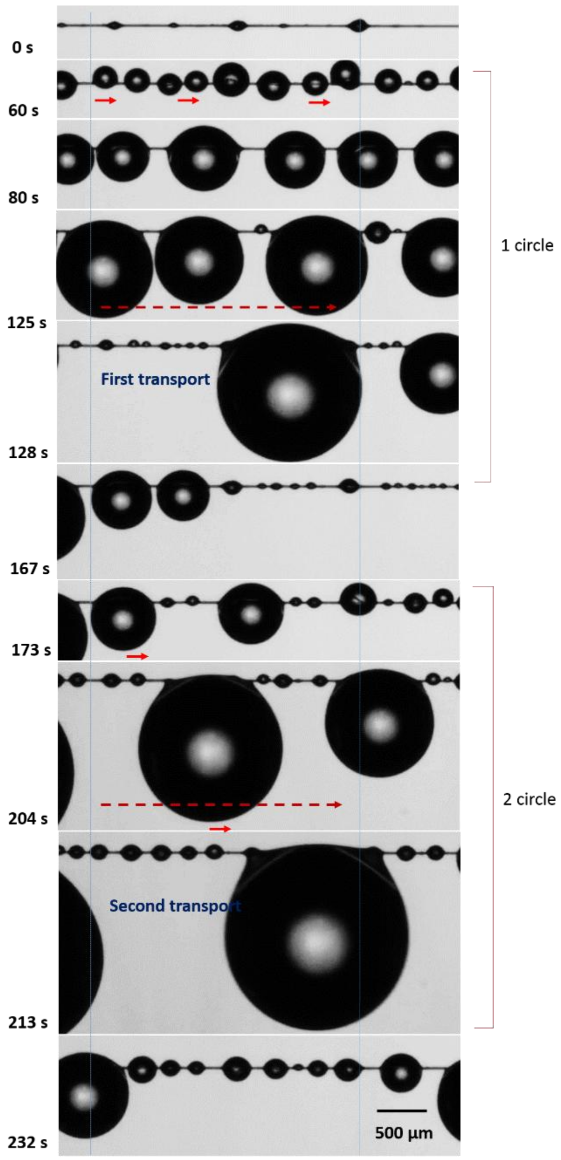

Figure S3 | Images of repeatability of droplet transport process. From 0 s to ~ 128 s, the water drops complete the first transport process. Then the biggest drop falls down from the bioinspired fiber. At ~ 167 s, the small drops continuously grow on the spindle-knots and start the second transport. At ~ 213 s, the second transport process finishes. Then the third transport process begins at ~ 232 s. These images show the repeatability of drop transport process. The bioinspired fiber can continuously transport the water drops.

Figure S4:

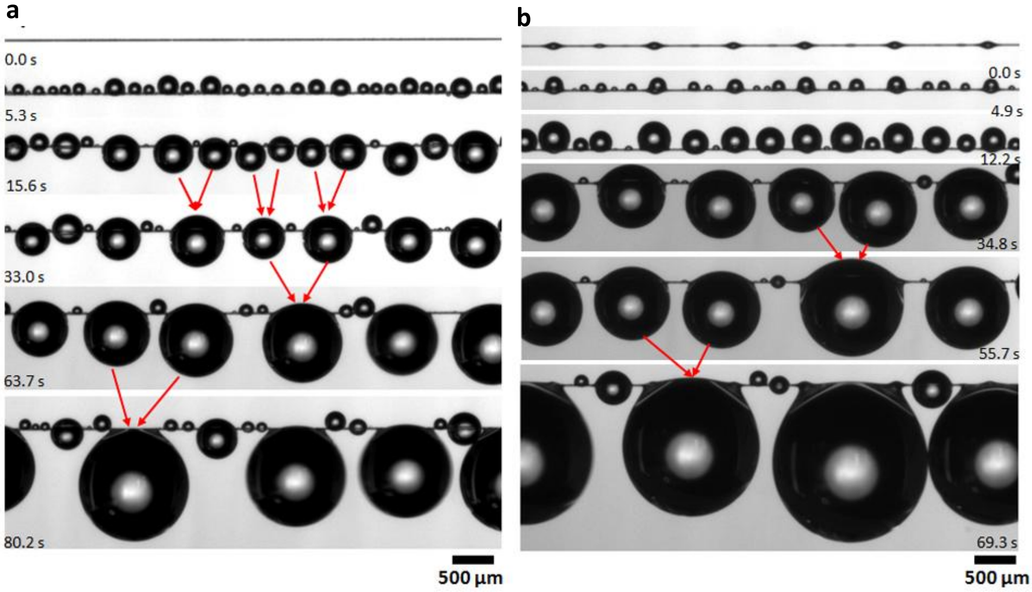

Figure S4 | Optical images show water drops coalescence on the uniform nylon fiber and uniform spindle-knots fiber. The uniform nylon fiber is coated with PVDF. Two fibers are horizontally placed under a humidity of more than 90% via fog flow at rate of ~ 30 cm/s. There are no obvious movements of water drops for a long distance. The water drops are coalesced with surrounding drops and stay on the original position (on the uniform nylon fiber (a) or stably hang on two spindle-knots on the uniform spindle-knots fiber (b).

Figure S5:

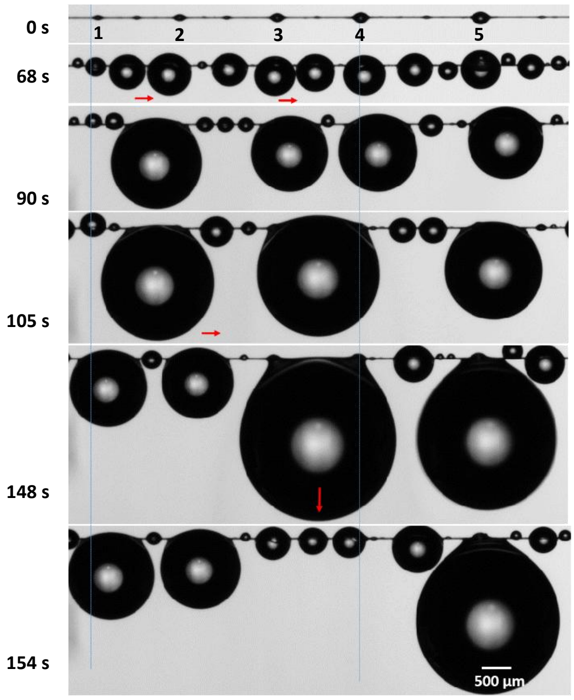

Figure S5 | Water transport affected by too big pitch. A gradient fiber is fabricated by title angle dip-coating with 15° and 8% concentration solution. A gradient spindle-knot fiber with five spindle-knots (marked with number 1→ number 5, height: ~ 57 μm, ~ 76 μm, ~ 148 μm, ~ 246 μm, ~ 286 μm; width: ~ 89 μm, ~ 106 μm, ~ 256 μm, ~ 296 μm, ~ 348 μm respectively) is selected. The pitches of two adjacent spindle-knots (from 1 to 5) are ~ 1.4 mm, ~ 1.5 mm, ~ 1.4 mm and ~ 1.8 mm, respectively. The largest pitch is too big to water transport. The movement distance of water drops is limited by the last pitch (between 4 and 5).

Supplementary Tables

Table S1. Viscosity (η) and surface tension (γ) of PVDF solutions with different concentration

Concentration (weight %)	Viscosity (η) (mPa·s)	Surface tension (γ) (mN/m)
7%	144	36.379±0.124
8%	216	36.612±0.115
9%	316	36.729±0.242
10%	460	36.823±0.213

Table S2. The length of largest pitch of two spindle-knots

Length (mm)	7%	8%	9%	10%
15°	2.0	1.4	––	––
10°	1.5	1.5	0.9	––
5°	1.4	1.5	1.4	1.2

Table S3. Result of fitting relationship between Height (H) of spindle-knot and Velocity (V) of drop coalescence via analyst of Origin software.

Equation	$V=A1 \cdot \exp(-H/t1)+V_0$		
Adj. R-Squr	0.96318		
		Value	Standard Error
	V_0	0.15707	0.02249
	A_1	-0.14478	0.02002
	t_1	204.6485	52.8495

Supplementary Movie (Movie S1).

In-situ observation of the water collection and drop transport are focused on the BFGS with three gradient spindle-knots observed under humidity of ~ 95% via fog flow at velocity of ~ 30 cm s^{-1} at room temperature, which was recorded by CCD camera. The dynamic process can be seen in Supplementary Movie S1.

Movie S1: Water collected quickly by the transport of coalesced drops.