Supplementary Information:

Stronger water hanging ability and higher water collection efficiency of bioinspired fiber with multi-gradient and multi-scale spindle knots

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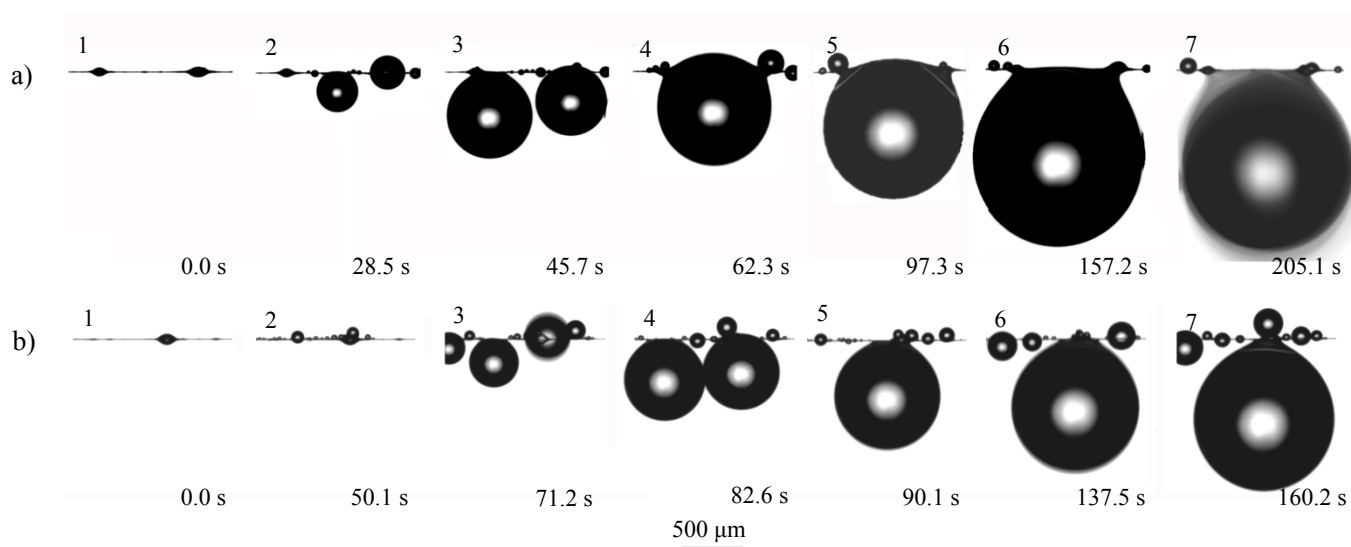
Fig. S1:

Fig.S1 a) Optical image of directional water collection that observed on two spindle-knots of bioinspired fiber. Water is collected (Frame 1-3) and coalesced (Frame 4) and grown (Frame 5-6). And extreme hanging drop forms (Frame 7) for a new circling of water collection again. The distance between the spindle-knots is short and the water drop is rooted on the two spindle-knots during coalescence of water drops. Finally, water drop detaches from two spindle-knots. b) Optical images of directional water collection that observed on one spindle-knot of bioinspired fiber. Water is collected (Frame 1-4) and coalesced (Frame 5) and grown (Frame 6) and extreme hanging drop forms before detaching off from fiber (Frame 7). The distance between the spindle-knots is long and every spindle-knot collects water, respectively. Finally, water drop detaches from single spindle-knot.

An appendix:

As illustrated in Fig. S2, when water drop detaches from two large spindle knot surface, the TCL is composed of two large half-ellipses (L_1), five small ellipses (L_2) and two lines (L_3). The length of TCL (L) could be written as:

$$
\begin{aligned}
L =\ & L_1 + L_2 + L_3 \\
=\ & \{\{1/2[2\pi B_1 + 4(A_1 - B_1)] + 2B_1\} + \{1/2[2\pi B_2 + 4(A_2 - B_2)] + 2B_2\}\} \\
& + \{[2\pi b_1 + 4(a_1 - b_1)] + [2\pi b_2 + 4(a_2 - b_2)] + [2\pi b_3 + 4(a_3 - b_3)] + [2\pi b_4 + 4(a_4 - b_4)] + [2\pi b_5 + 4(a_5 - b_5)]\} \\
& + 2[m - A_1 - A_2 - 2(a_1 + a_2 + a_3 + a_4 + a_5)] \\
=\ & 2m + \pi(B_1 + B_2) + 2(\pi - 2)(b_1 + b_2 + b_3 + b_4 + b_5)
\end{aligned}
$$

where $2A_1$, $2A_2$ and $2B_1$, $2B_2$ are the length and height of large spindle knots. $2a_1$, $2a_2$, $2a_3$, $2a_4$, $2a_5$ and $2b_1$, $2b_2$, $2b_3$, $2b_4$, $2b_5$ are nth the length and height of small spindle knots (n= 1, 2, 3, 4, 5). m is the contact length between water drop and fiber.
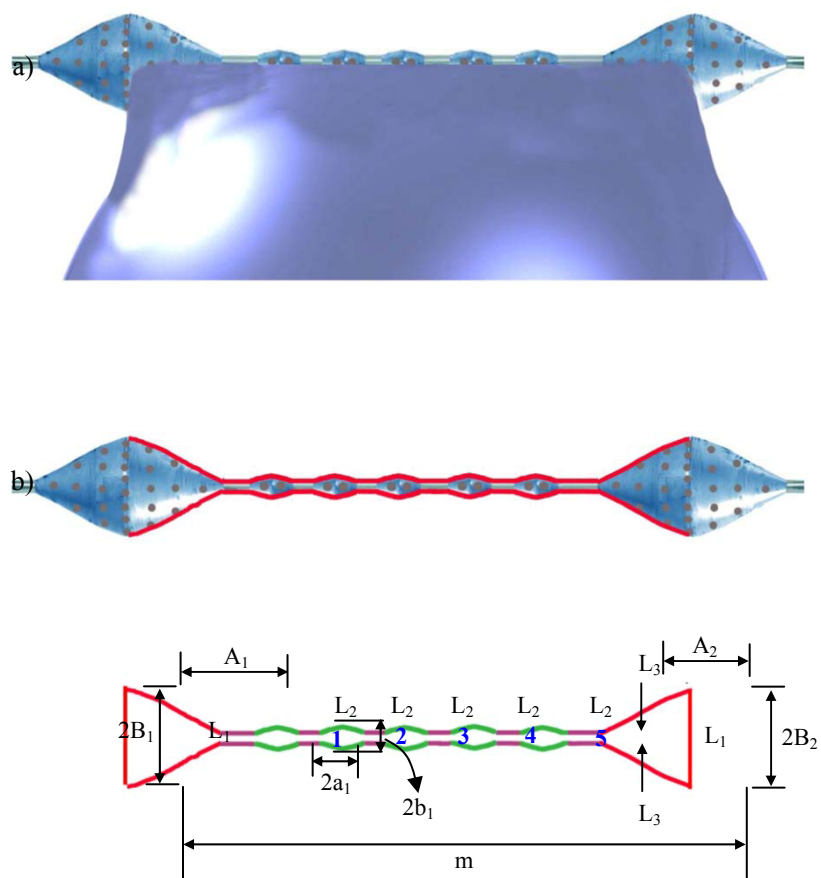
Fig. S2:

Fig.S2 Model illustration of water droplet hanging at threshold conditions: a) the side view, b) the top view, the bottom is the illustration of solid-liquid lines when water drop detaches from two large spindle knot surface.