

Self-alignment Capillary Gripper for Microfiber Manipulation

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Abstract—The assembly and arrangement of microfibers have wide applications in biomedicine, material science, and microsystem. However, current micromanipulation methods for positioning and orientating individual microfibers are complex and hard to use. In this paper, we report a novel self-alignment capillary gripper for microfiber manipulation that is facile and convenient. We determine the key parameters of the gripper including the required meniscus volume and the tip aspect ratio of the gripper through both numerical simulation and experimental investigation. A two-stage self-alignment process is employed to achieve high precision. The gripper can pick up and self-align microfibers with an aspect ratio of up to 300:1 at an accuracy of $2.1 \pm 2.0 \mu\text{m}$ and $0.6 \pm 0.6^\circ$ or better and create highly parallel linear arrays. The gripper is also versatile, where multiple types of microfibers including glass fibers, carbon fibers, dandelion seed fibers, and cat hairs can be picked up and self-aligned. Additionally, the gripper can construct two-dimensional patterns and plug a fiber into a micro glass capillary.

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