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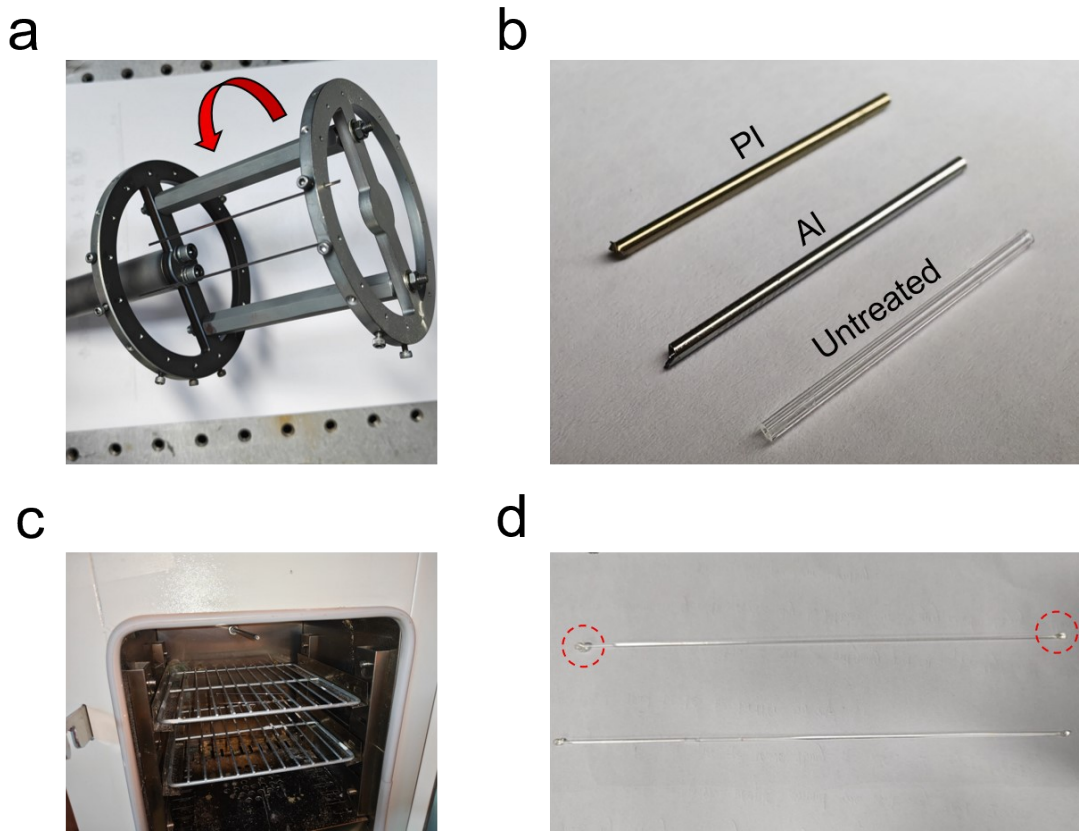
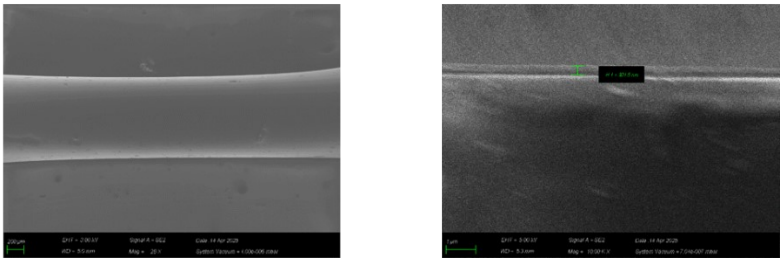
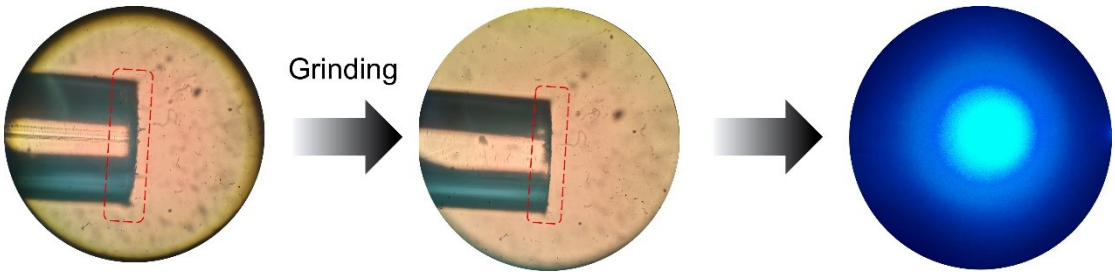


Supplementary Fig. 1 | Capillary surface modification procedure.
a, A rotary evaporation process was employed to deposit an aluminum layer onto the surface. **b**, The untreated capillaries underwent sequential coating, first with an aluminum (Al) film and then with a protective polyimide (PI) layer. **c**, The surface was treated in an oven at 75 °C, and subsequently coated with a polyimide (PI) layer at 240 °C. **d**, Both ends of the capillary were sealed with UV-curable adhesive during the surface functionalization process.

a b

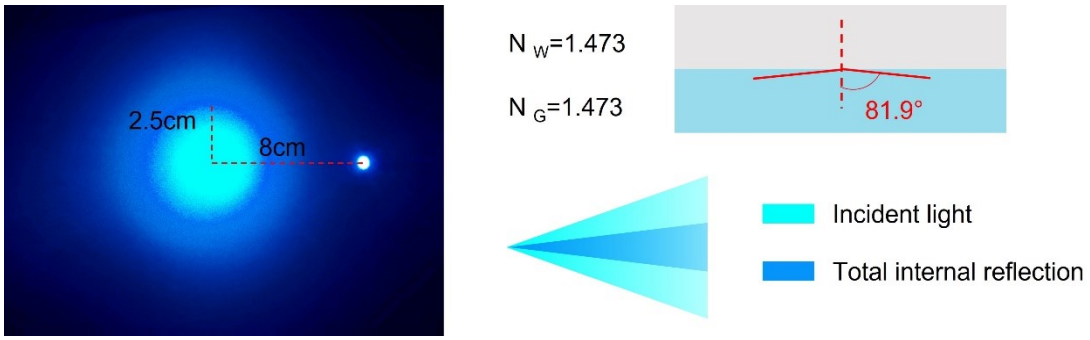


Supplementary Fig. 2 | SEM image of the metal-coated capillary surface.
a, scale: 200 μm **b**, scale: 1 μm



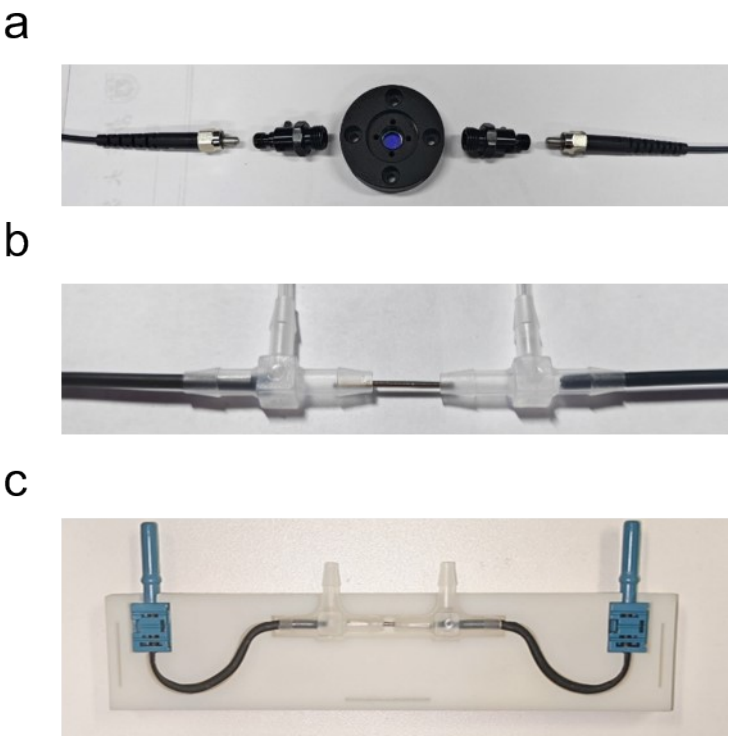
Supplementary Fig. 3 | Fiber optic polishing result

After being cleaved, the fiber core's cross-section was uneven and had burrs. Following polishing with abrasive paper and lapping oil, it exhibited a uniform light-spot pattern.



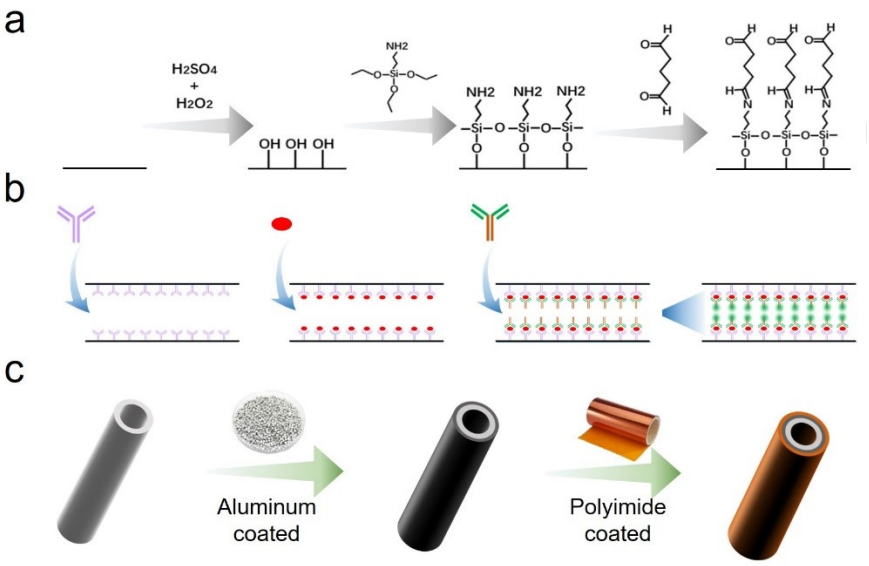
Supplementary Fig. 4 | Total internal reflection effect after adding glycerin

Using the refractive indices of glycerin and fused silica at room temperature, the corresponding critical angle is calculated, and the portion of the beam that undergoes total internal reflection is determined from the actual emergent light spot.



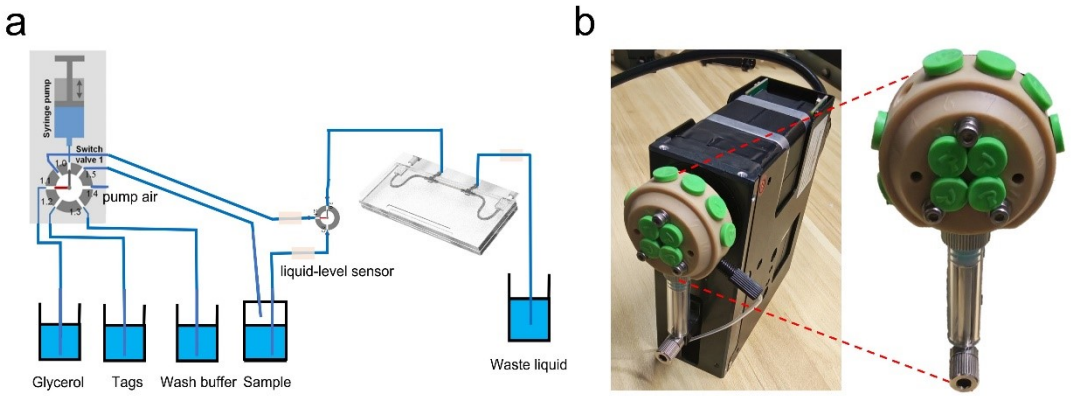
Supplementary Fig. 5 | Image of the fabricated chip

a, Optical filter module components, including plastic optical fibers, collimators, and optical filters. **b**, Hollow optical fiber module, including a three-way valve, plastic optical fibers, and a capillary tube. **c**, Embedded chip comprising a resin-printed base, a hollow-core fiber module, and an optical fiber coupler.



Supplementary Fig. 6 | Capillary surface treatment protocol

a, Inner-wall modification workflow **b**, Full process from inner-wall functionalization to target capture **c**, Outer-wall metallization protocol



Supplementary Fig. 7 | Syringe-pump operation sequence and physical photograph **a**, Sequential injection protocol of the syringe pump **b**, Physical photograph of the syringe pump and modules