Supplementary Information for

Parallel Fabrication of Silica Optical Microfibers and Nanofibers

Hubiao Fang[1], Yu Xie[1], Zipei Yuan[1], Dawei Cai[1], Jianbin Zhang[1], Xin Guo[1,2,*], and Limin Tong[1,2,3,*]

[1] Interdisciplinary Center for Quantum Information, New Cornerstone Science Laboratory, State Key Laboratory of Extreme Photonics and Instrumentation, College of Optical Science and Engineering, Zhejiang University, Hangzhou 310027, China.

[2] Jiaxing Key Laboratory of Photonic Sensing & Intelligent Imaging, Intelligent Optics & Photonics Research Center, Jiaxing Research Institute, Zhejiang University, Jiaxing 314000, China.

[3] Collaborative Innovation Center of Extreme Optics, Shanxi University, Taiyuan 030006, China.

*Correspondence: X. Guo, E-mail: guoxin@zju.edu.cn; L. M. Tong, E-mail: phytong@zju.edu.cn.

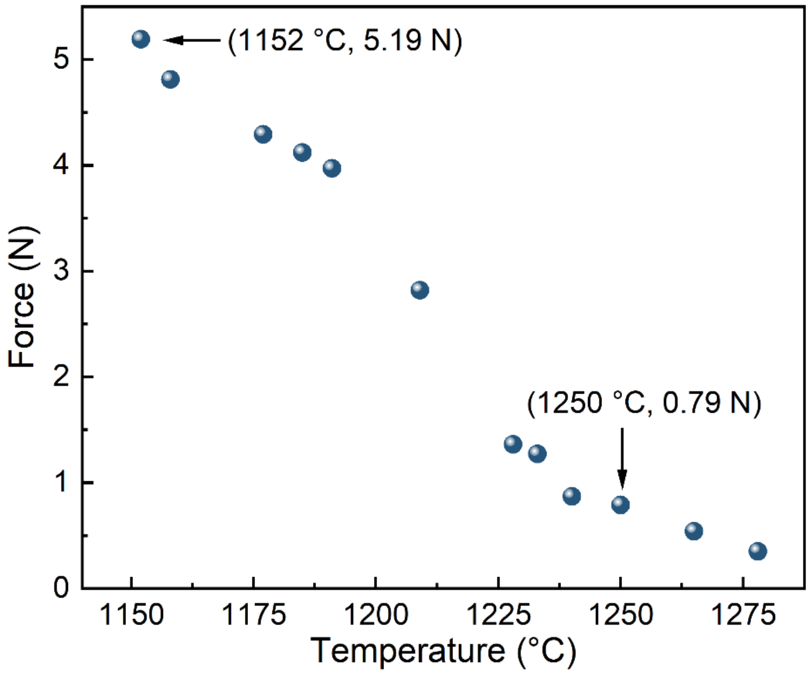

Figure S1. Maximum tensile force during the fiber drawing process at different temperatures. The maximum tensile force during the fiber (Corning SMF-28e) drawing process is measured at different temperatures ranging from 1152 °C to 1278 °C, with a fixed drawing speed of 0.1 mm/s. Within the selected temperature (1240 °C to 1250 °C) for parallel drawing of a 20× fiber array, the total tensile force is ranging from about 15.8 N to 17.4 N.

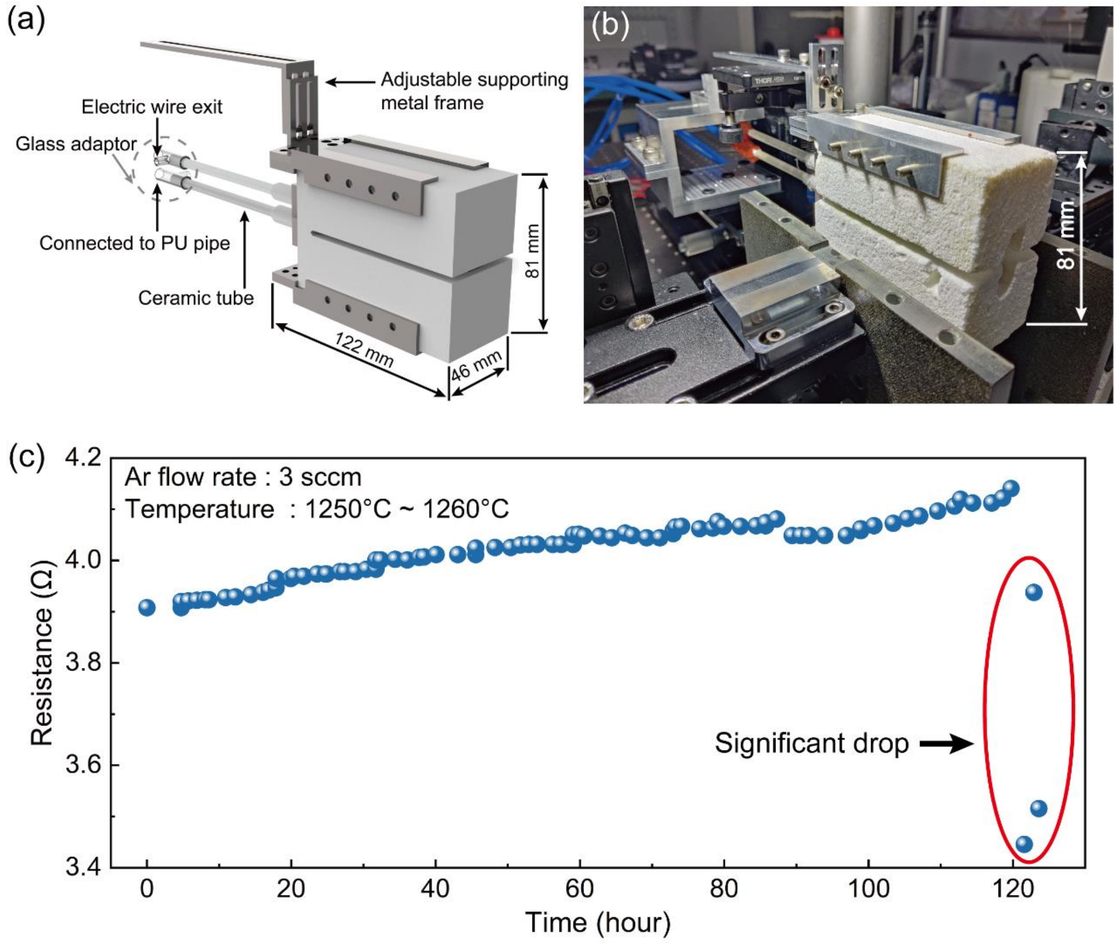

Figure S2. Additional information on the electric heater. a, schematic diagram of the electric heater (122 mm in length, 46 mm in width, and 81 mm in height). Two ceramic tubes (80 mm in length) are used to connect the heater and glass adaptors, which can effectively block the thermal conduction (e.g., when the heater temperature reaches 1030 °C, the temperature of the glass adaptor is 67 °C). Two copper wires are used to connect an external power source and the heating wire (i.e., FeCrAl-alloy wire) through one end of glass adaptors and ceramic tubes. The other end of the glass adaptors is connected to polyurethane tubing (PU) tubes for providing argon gas. To maintain an airtight environment, the joints of the glass adaptors are sealed with sealants; **b**, photograph of the electric heater. The heater is fixed on a manual three-dimensional linear stage with a pitch & roll-adjustable platform. Furthermore, the manual three-dimensional linear stage is placed on a long-travel one-dimension electric linear stage, for stable forward and backward motion control of the heater at the beginning and end of the fiber drawing process, respectively; **c**, electrical resistance of the heating wire versus the cumulative operating time. The operating temperature of the heater falls between 1250 °C and 1260 °C, with an argon-gas flow rate of 3 sccm for each ceramic tube. The increasing resistance indicates the aging of the heating wire. Before the damage of the heating wire caused by thermal deformation and local high temperature occurs, a significant drop in resistance from 4.1 Ω to 3.5 Ω can be observed at ~120 h, which is a signal to replace the heating wire.

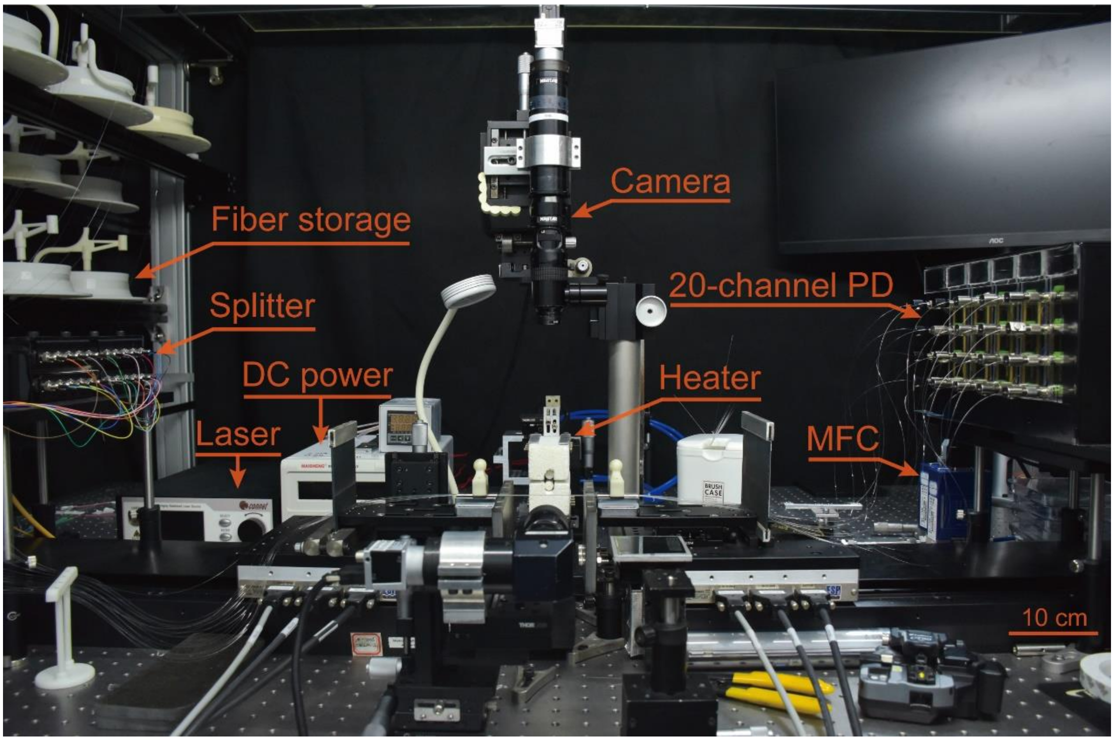

Figure S3. Photograph of the parallel fabrication system of MNFs. Fiber storage is used to store optical fibers that are connected to outports of optical splitter. Direct current (DC) power is used to supply power for the electric heater. MFC, mass flow controller; 20-channel PD, 20-channel photodetector.

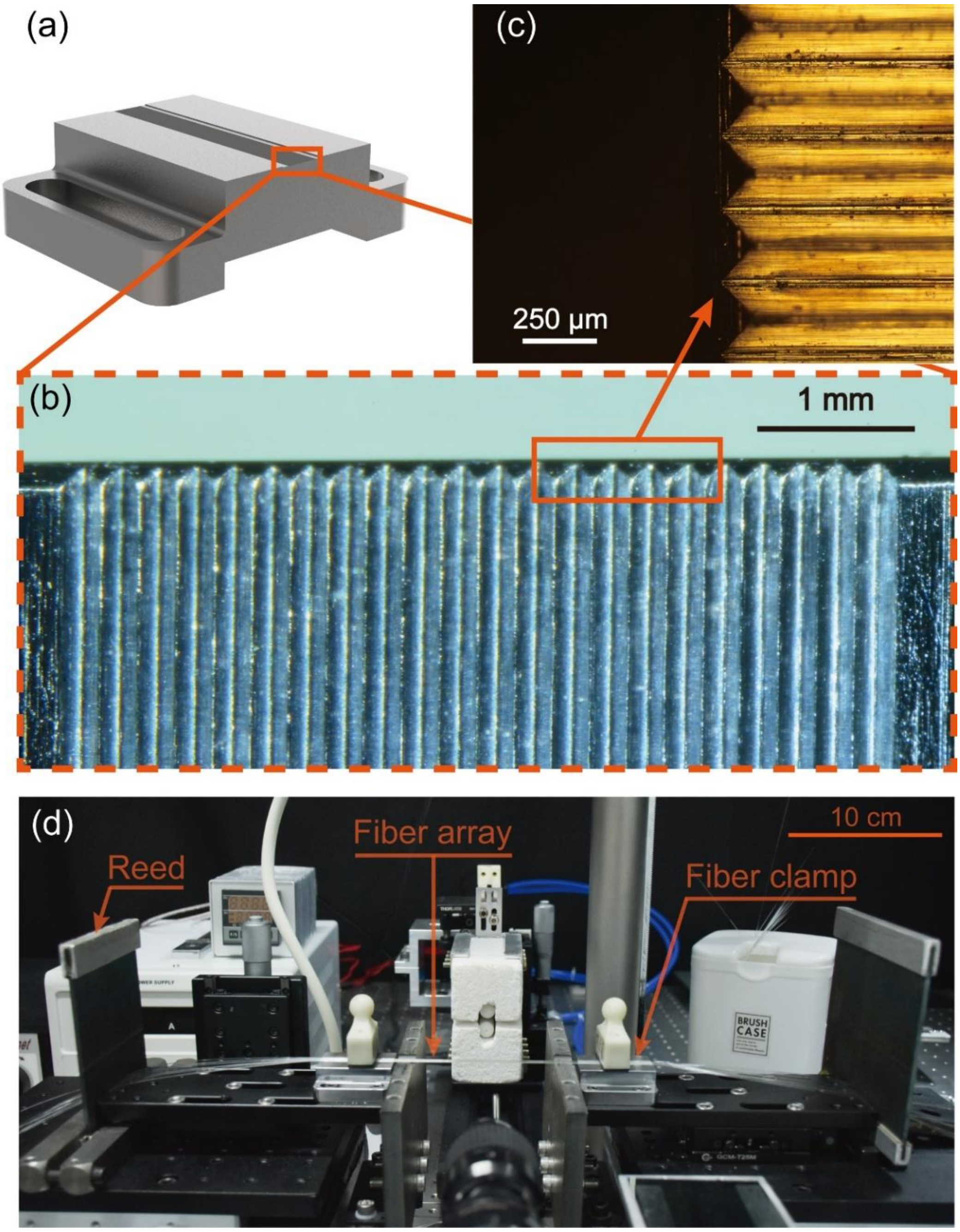

Figure S4. Fiber array clamps and reeds. a, fiber-array clamp with 22 continuous V-grooves. The center distance of each adjacent groove is 250 μm; **b**, optical microscope image of the whole 22 V-grooves; **c**, close-up optical microscope image of the V-grooves (focused on the bottom of the V-grooves); **d**, photograph of the clamps and reeds. The reeds are used to prevent optical fibers from entanglement.

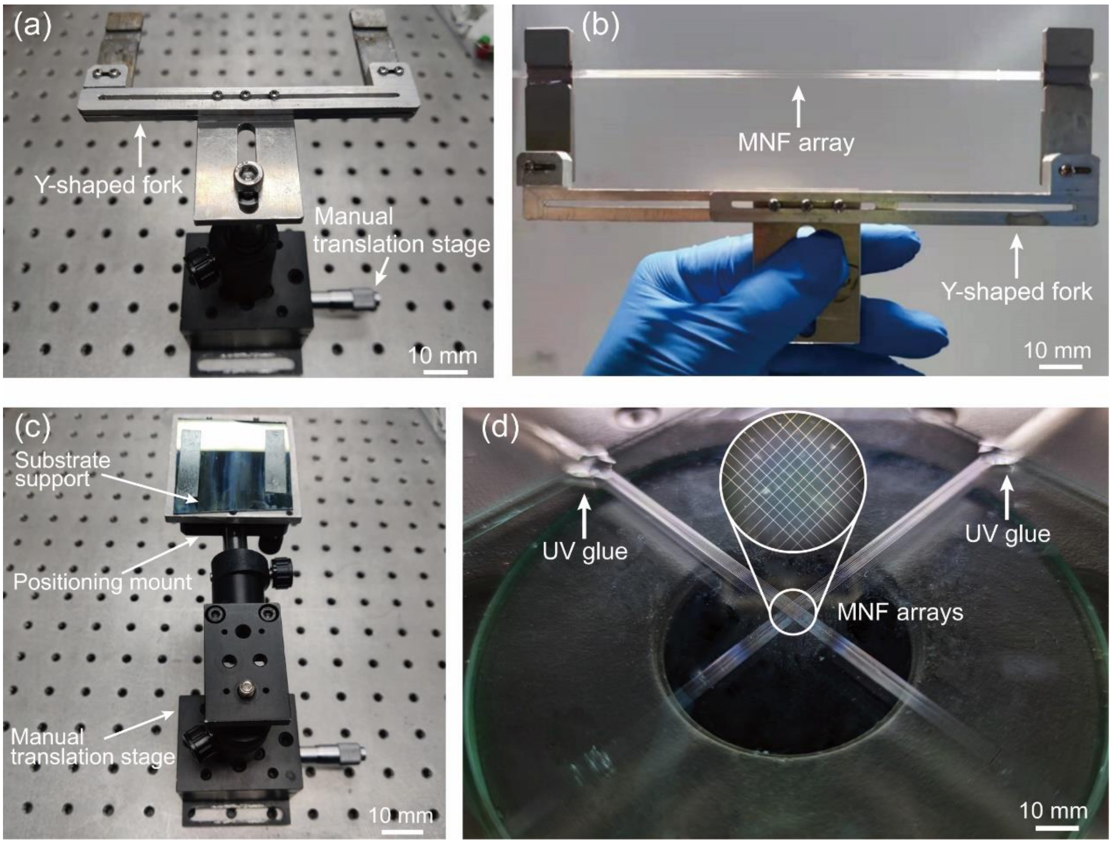

Figure S5. Fiber array transfer tools. a, tool for transferring a free-standing MNF array. Typically, we place this tool under an as-fabricated MNF array, and use a manual translation stage to lift the Y-shaped fork to approach the array. When the fork is in contact with the MNF array, we firstly fix the array on the fork using a UV glue, and then remove the array from the clamps. The length of the Y-shaped fork can be adjusted for different MNF arrays; **b**, photograph of a transferred 10× MNF array with an average diameter of about 890 nm; **c**, tool for transferring MNF arrays on to substrates. The operation of transferring MNF arrays is similar to what is described in **(a)**, except that instead of a Y-shaped fork, a substrate is used; **d**, photograph of two transferred crossed MNF arrays. The average diameter of these MNF arrays is about 2 μm.