Supporting Information for

On Chip Gas Reaction Nanolab for In Situ TEM Observation

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Supplementary Figures

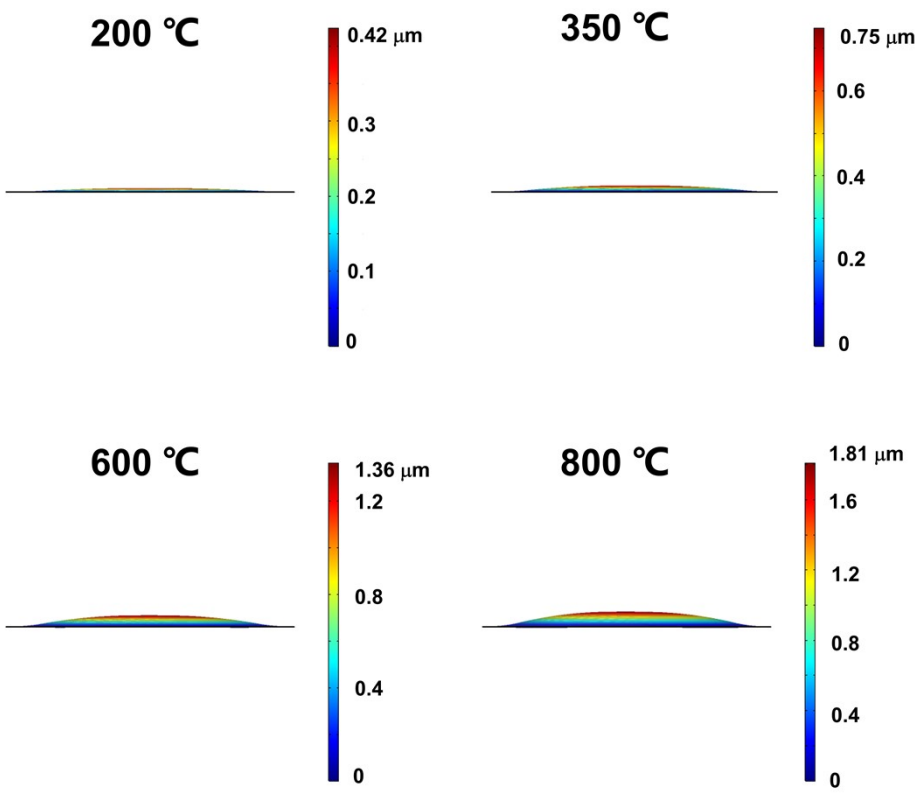

Fig. S1 Z-direction thermal expansion of the heater at different temperatures.

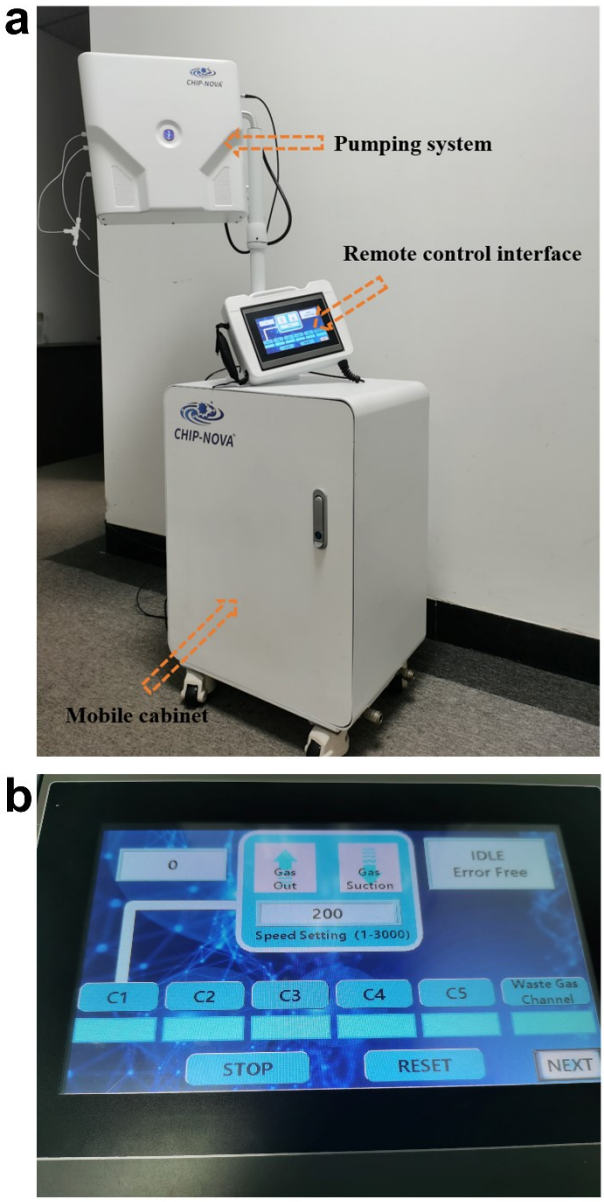

Fig. S2 (a) Photograph of in-situ nanofluidic control system. (b) Photograph of remote-control interface.

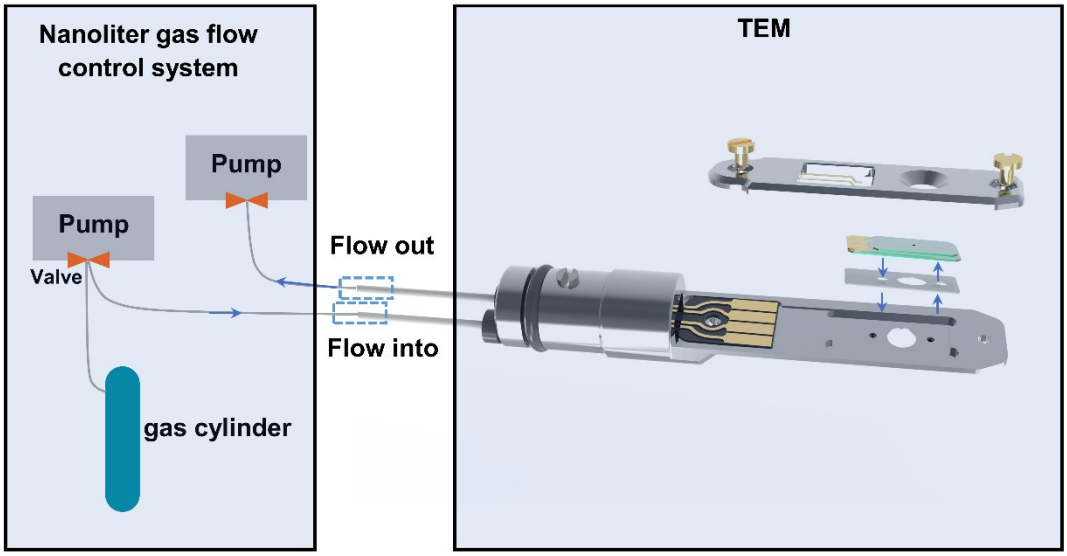

Fig. S3 Perspective view of nanoliter gas flow control system and schematic illustration of the detachable structure of gas flow holder.

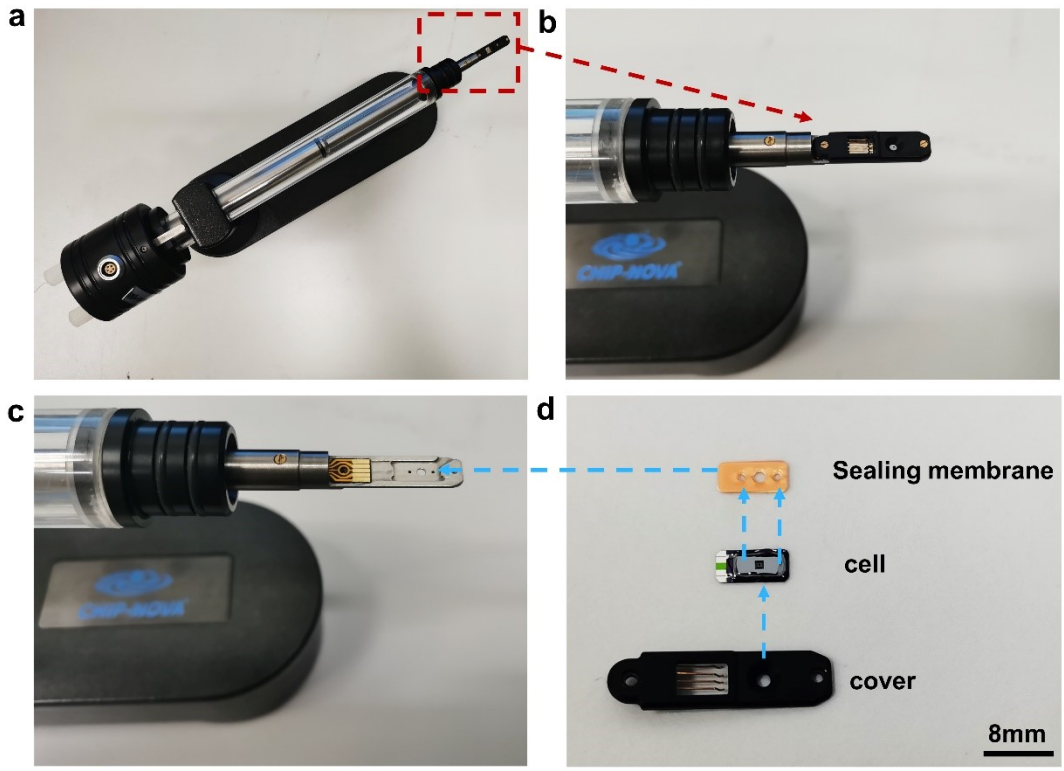

Fig. S4 (a) Photograph of the assembled gas flow holder from Chip-Nova. (b) Enlarged photograph of the gas flow holder head. (c) Photograph of the gas flow holder head before chip loaded. (d) Photograph of the sealing membrane, gas cell and the cover with electrical circuit.

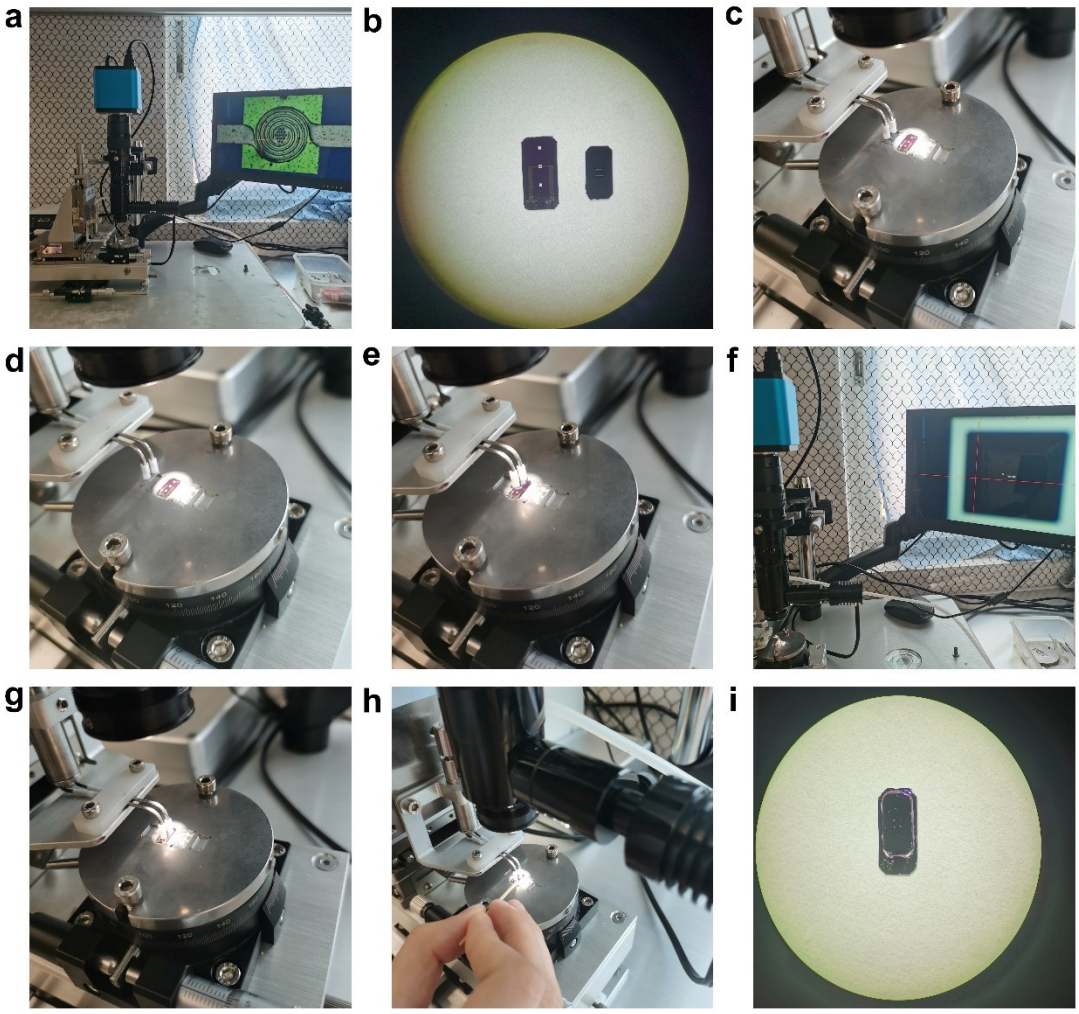

Fig. S5 Flow chart of chip assemble. (a) Photograph of chip assembly equipment. (b) Photograph of separated bottom chip and top chip. (c) Positions of bottom chip and top chip on chip assembly station. (d-e) Moving top chip with vacuum arm. (f) Alignment of chips. The bright SiNx window on the monitor representing the well alignment between top and bottom chip. (g) Lowing the top chip and contact with bottom chip. (h) Sealing the slit between bottom chip and top chip. i Photograph of assembled chip.

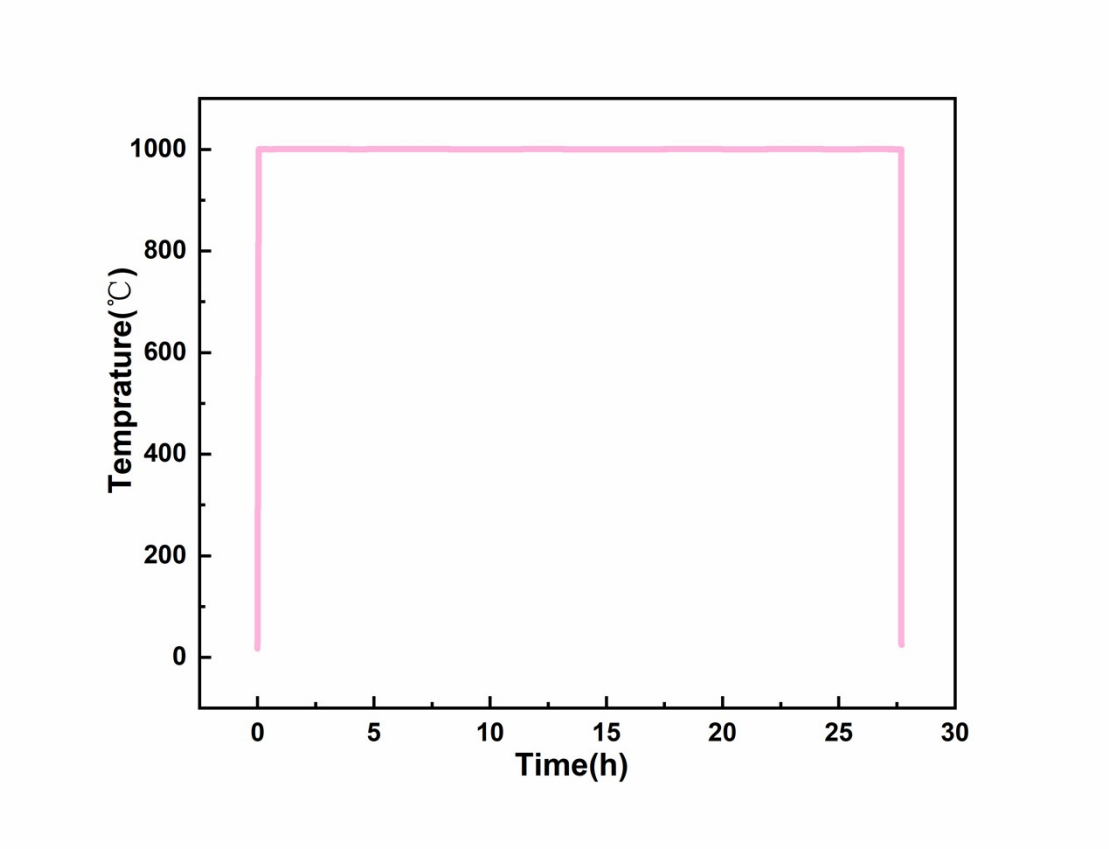

Fig. S6 Working time could be extending to more than 24 hours.

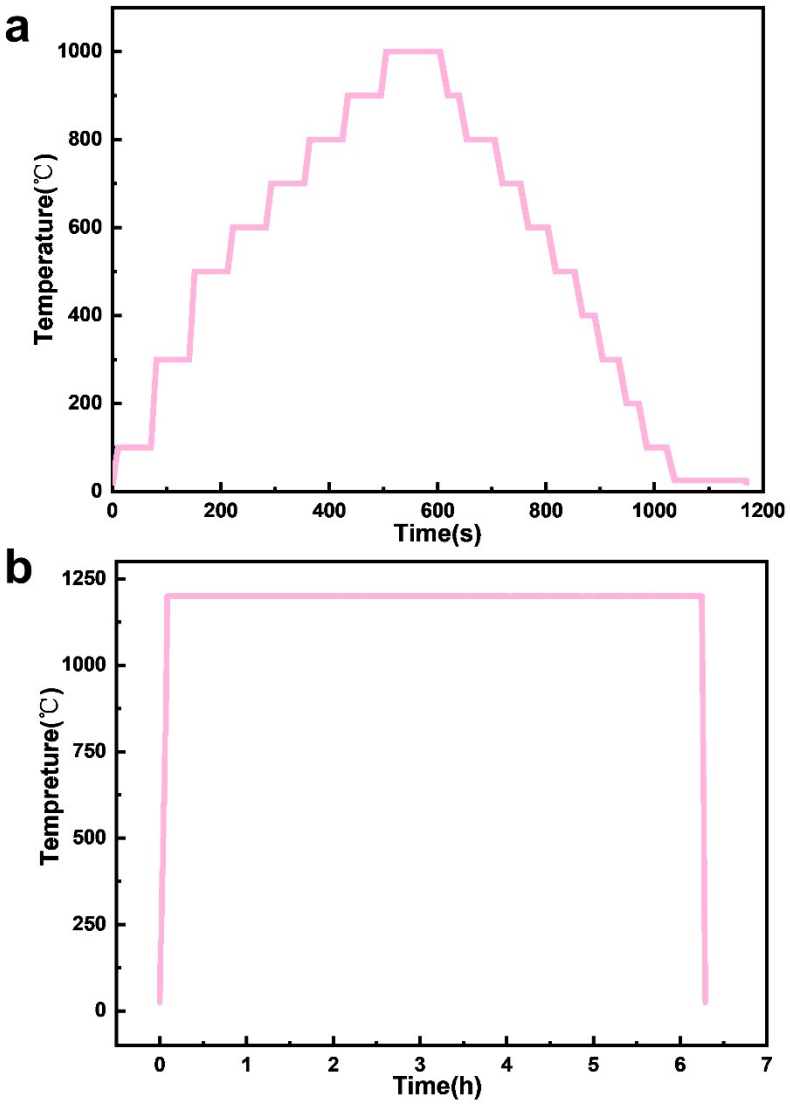

Fig. S7 (a) Programed heating and temperature curve. (b) Another around of heating was set up to 1200℃ and maintained 6 hours.

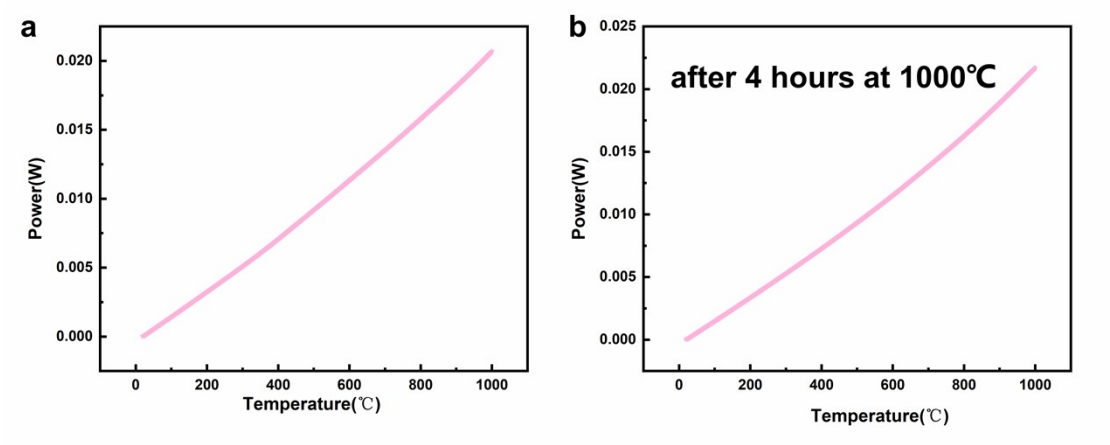

Fig. S8. Temperature-Power curve before and after long time high temperature heating.

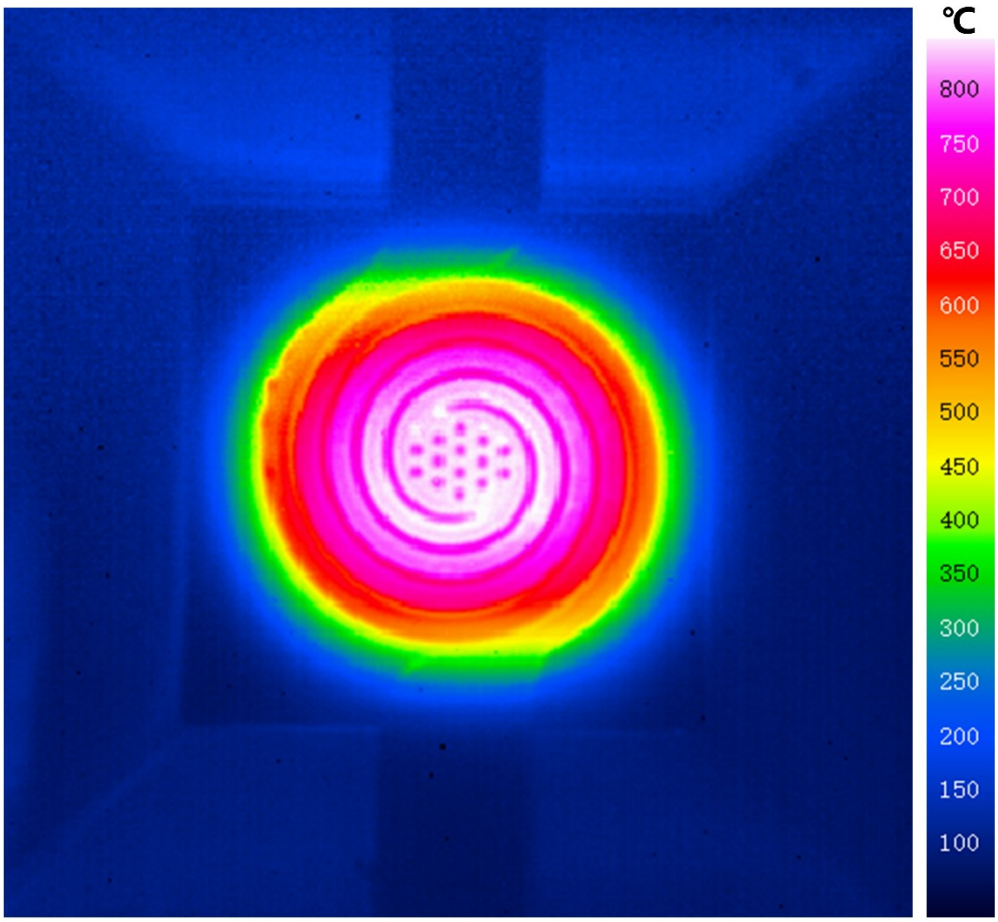

Fig. S9 Temperature distribution of the chip heat to 800℃ and measured by infrared camera.

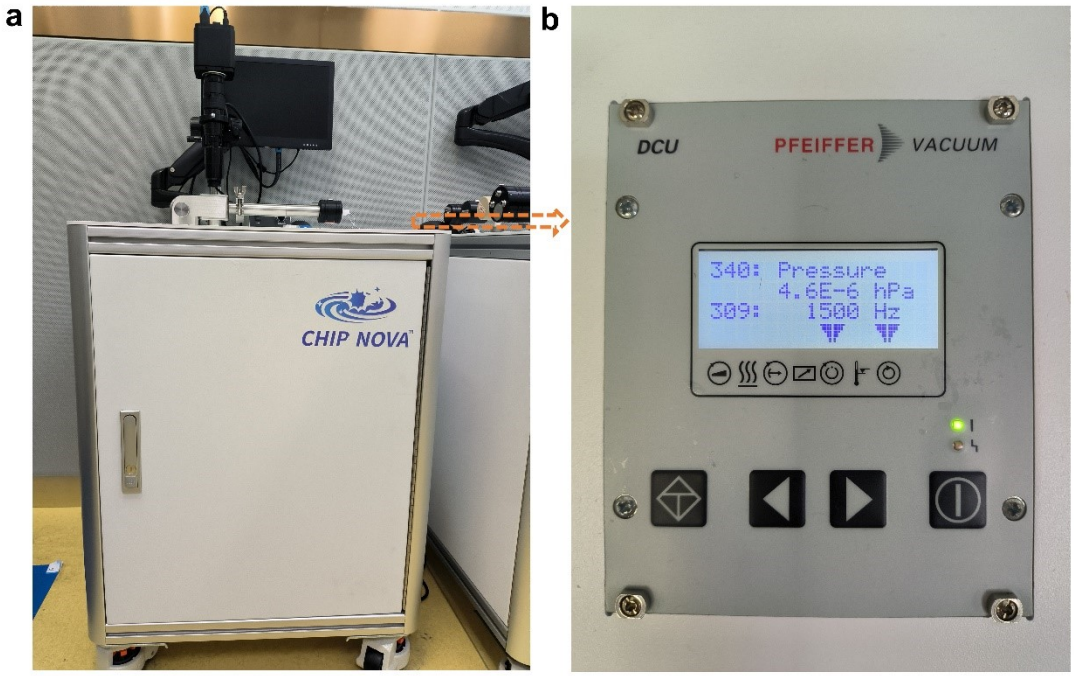

Fig. S10 (a) Photograph of the vacuum leak detector. (b) Interface showing the vacuum value.

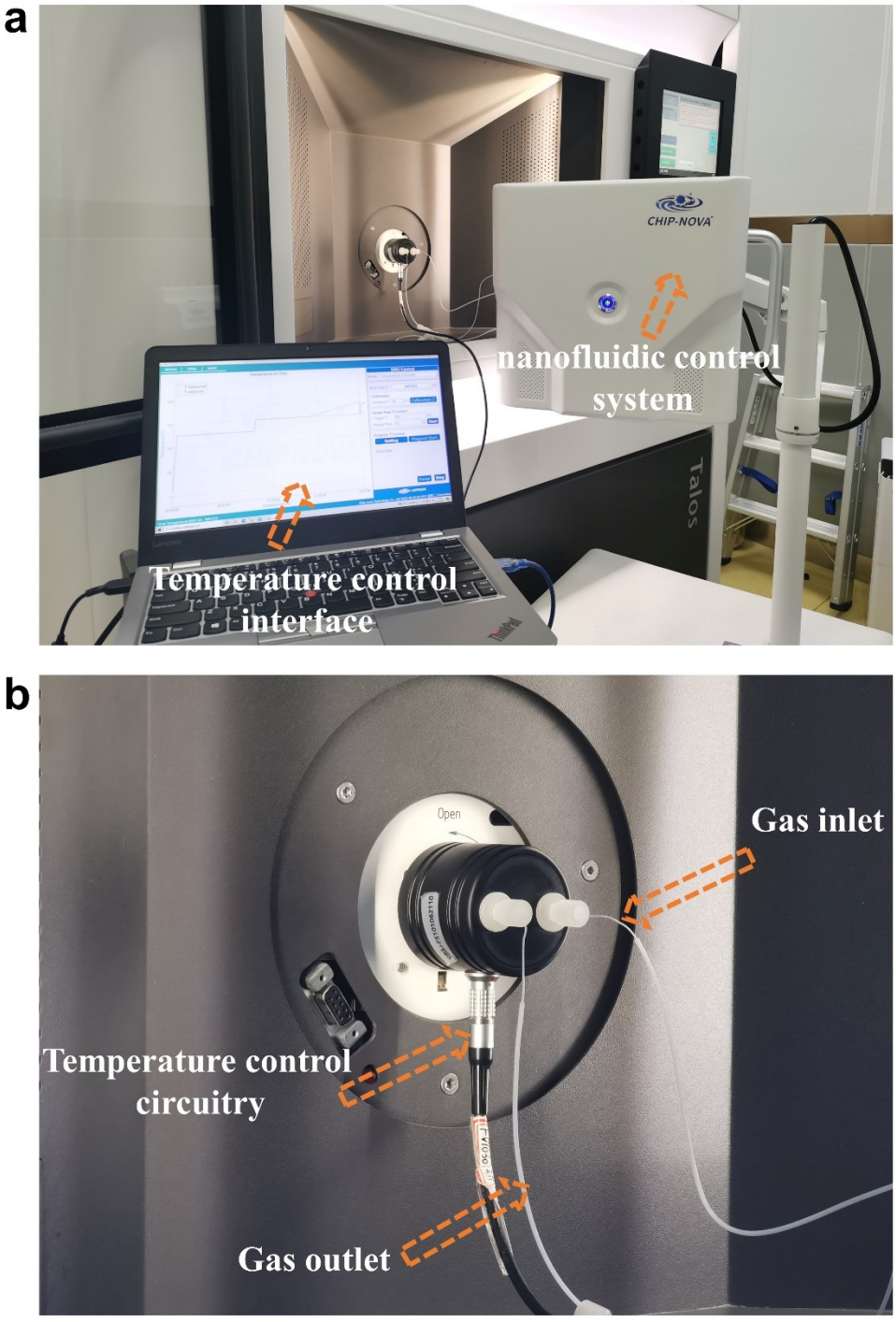

Fig. S11 (a) Photograph of equipment setup for in-situ experiment. (b) Photograph of the tubing connection to the gas holder.

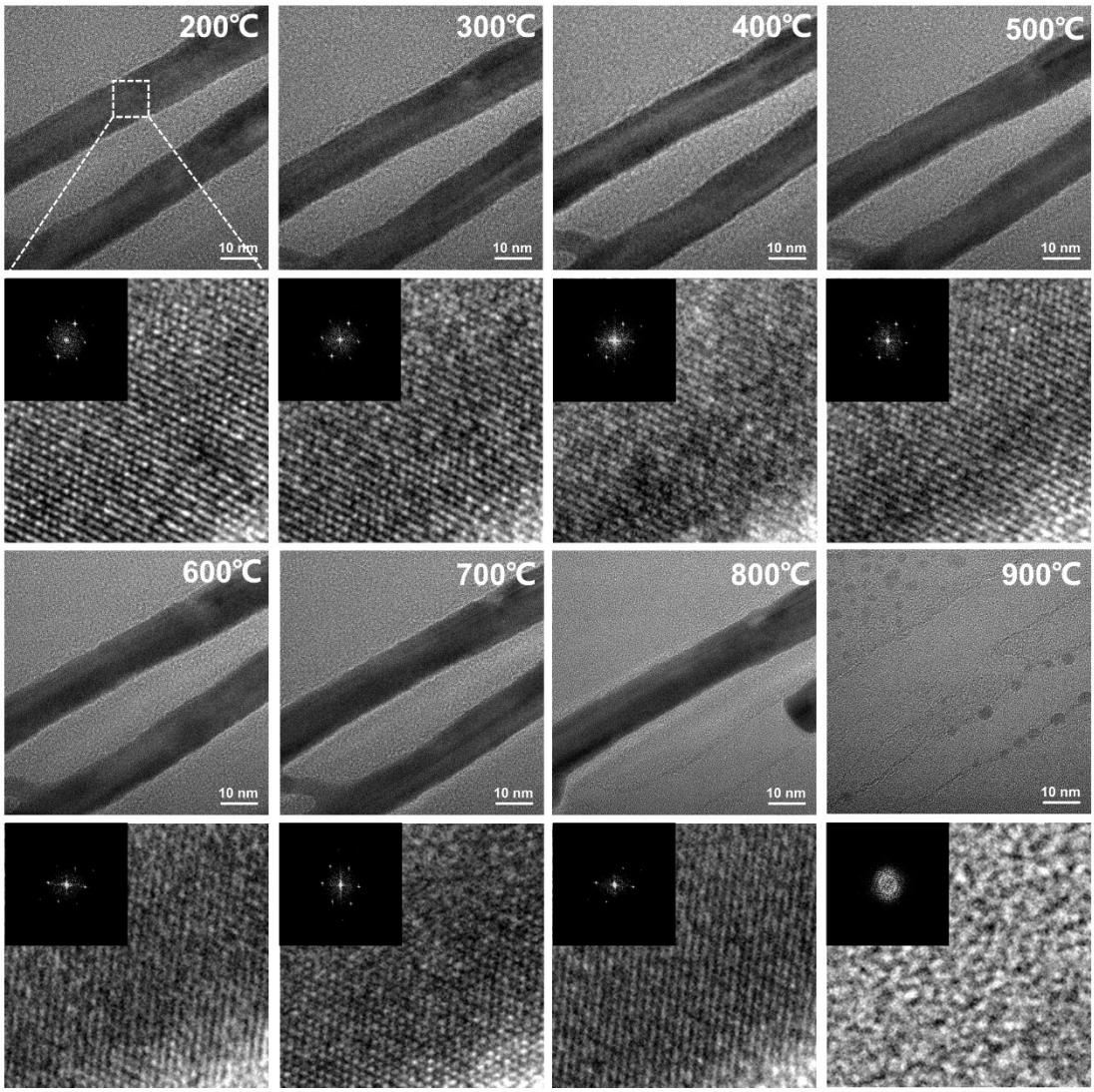

Fig. S12 Image sequences of Pd nanowires in nanoreactor during continuous heating, heating rate is 2℃/s.

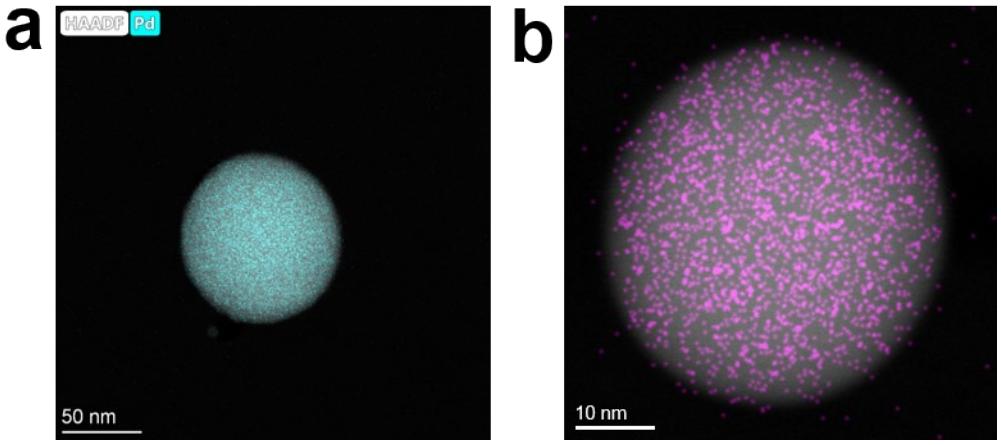

Fig. S13 EDS mapping of Pd droplet in Fig. 6a and Fig. 6b.

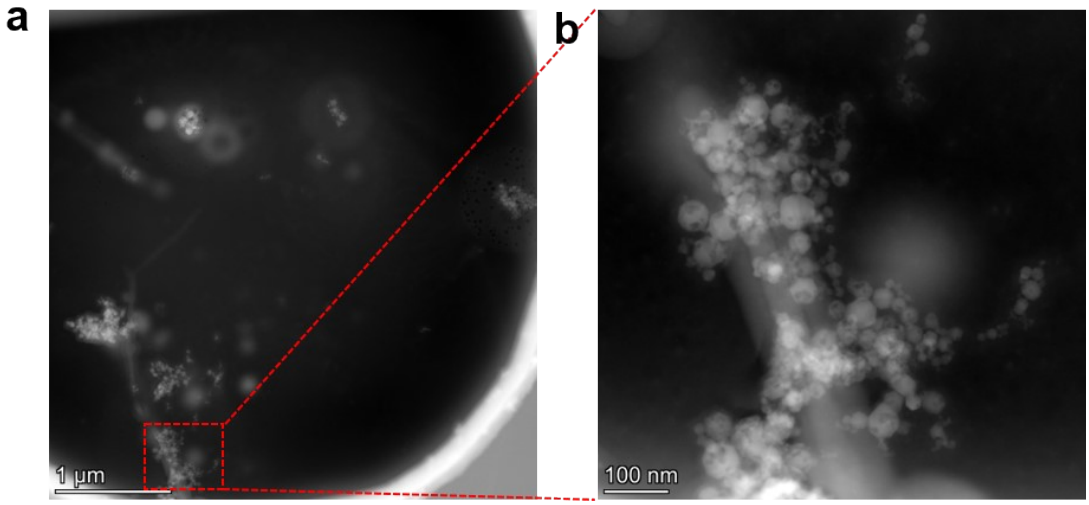

Fig. S14 Reduction of ferric oxide in nanolab. (a) STEM image of ferric oxide in hydrogen at low magnification. (b) Enlarged STEM image of Fig. S14a.

Supplementary Movies

Movie S1. The movie of the melting and creeping of alumina nanoparticles when temperature is maintained at 1300℃. The movie plays with 6× normal. Dose rate: 843 $e^-/(Å^2 \cdot s)$.

Movie S2. The movie of an interface between crystalline structure and liquid phase, which shows that the lattice fringes of Pd nanowire start to disappear from the right side. Dose rate: 1030 $e^-/(Å^2 \cdot s)$.

Movie S3. The movie of melting process of Pd nanoparticle whose interface gradually moved to the left, Pd nanoparticle partially melt and became spherical on top and bottom part. The movie plays with 20× normal. Dose rate: 1030 $e^-/(Å^2 \cdot s)$.

Movie S4. The movie of reduction of ferroferric oxide at 300℃ in on chip reaction nanolab. Holes appear in ferroferric oxide nanoparticles. The movie plays with 8× normal. Dose rate: 15 $e^-/(Å^2 \cdot s)$.

Movie S5. The enlarged movie of region 1 in Movie S4. The movie plays with 20× normal. Dose rate: 15 $e^-/(Å^2 \cdot s)$.

Movie S6. The enlarged movie of region 2 in Movie S4. The movie plays with 20× normal. Dose rate: 15 $e^-/(Å^2 \cdot s)$.

Movie S7. The enlarged movie of region 3 in Movie S4. The movie plays with 20× normal. Dose rate: 15 $e^-/(Å^2 \cdot s)$.