

# Silica Nanowires Part II: Fabrication



RS Seminar on Science and Technology of Silica Nanowires  
Kavli Institute of the Royal Society  
Milton Keynes, United Kingdom, 8 November 2012



# Nanowire fabrication

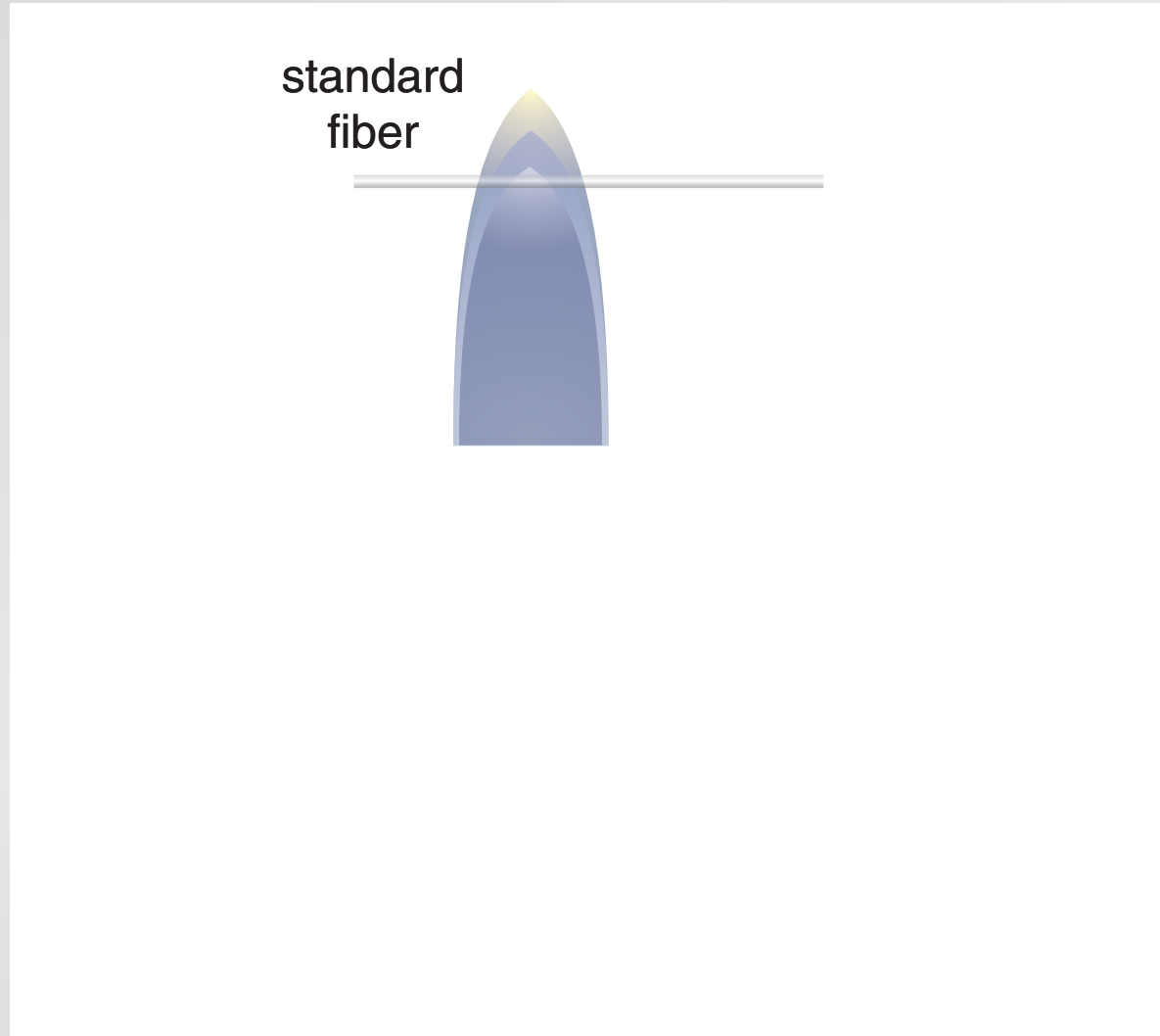
two-step drawing process

standard  
fiber



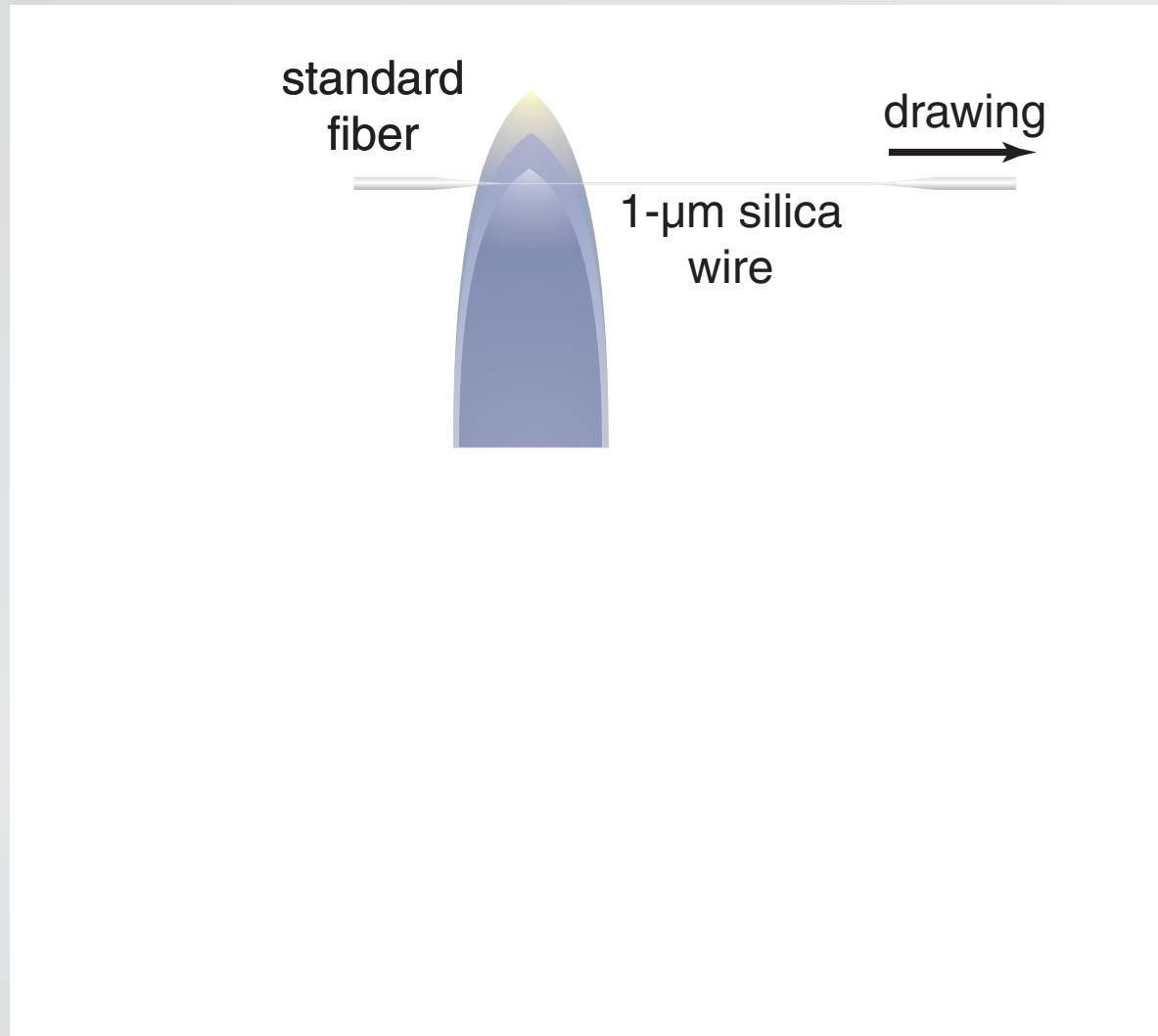
# Nanowire fabrication

two-step drawing process



# Nanowire fabrication

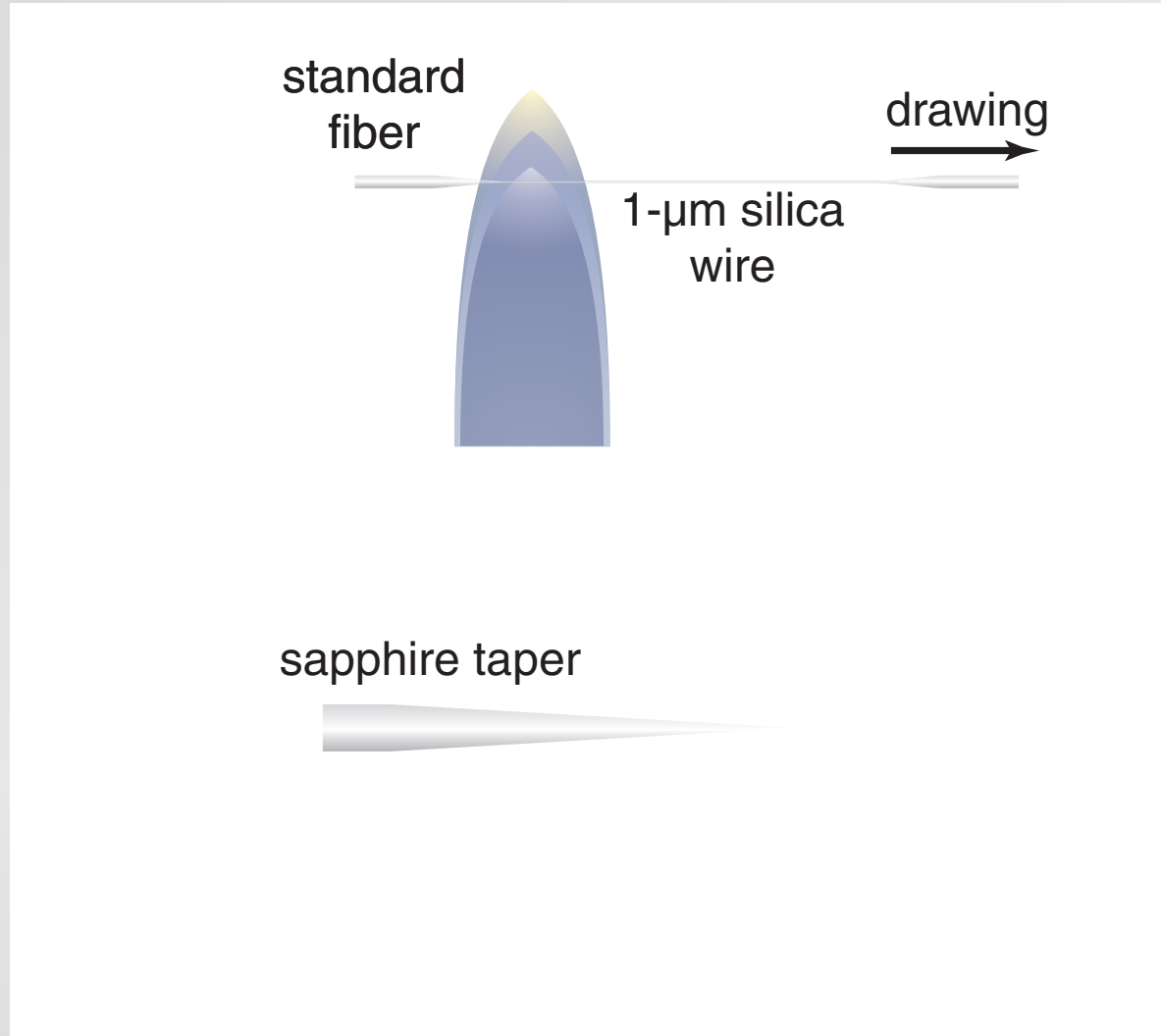
two-step drawing process





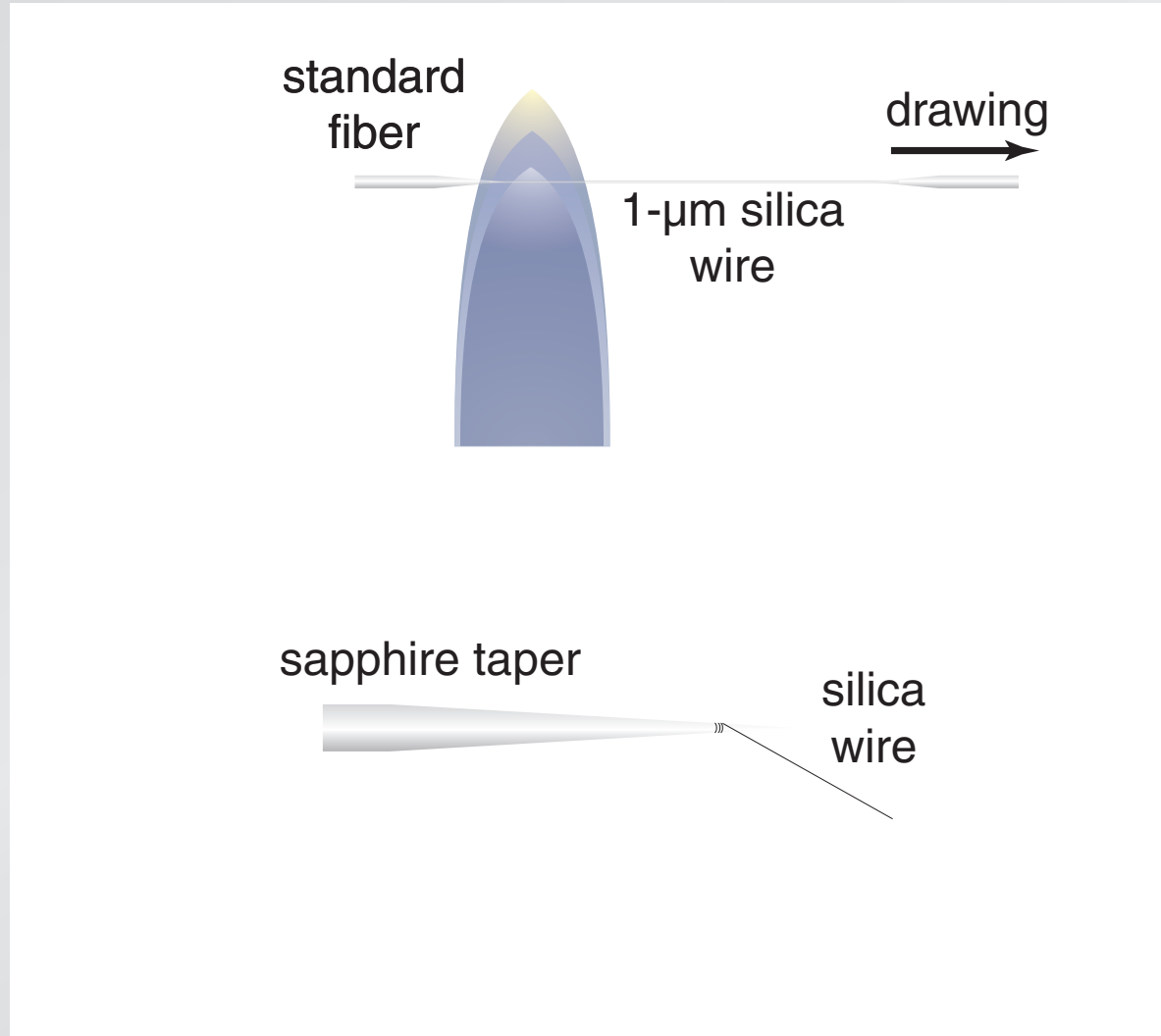
# Nanowire fabrication

## two-step drawing process



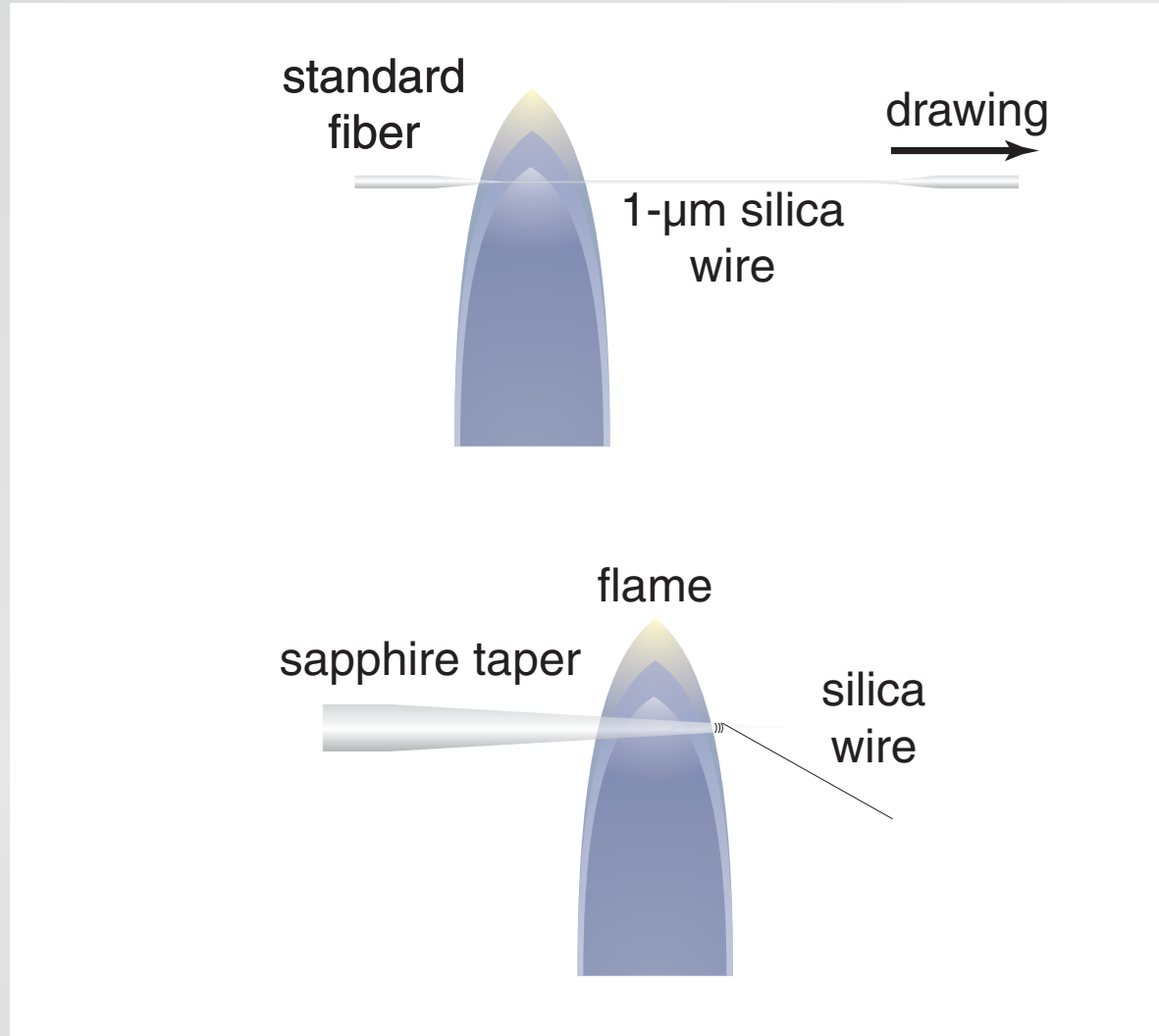
# Nanowire fabrication

## two-step drawing process



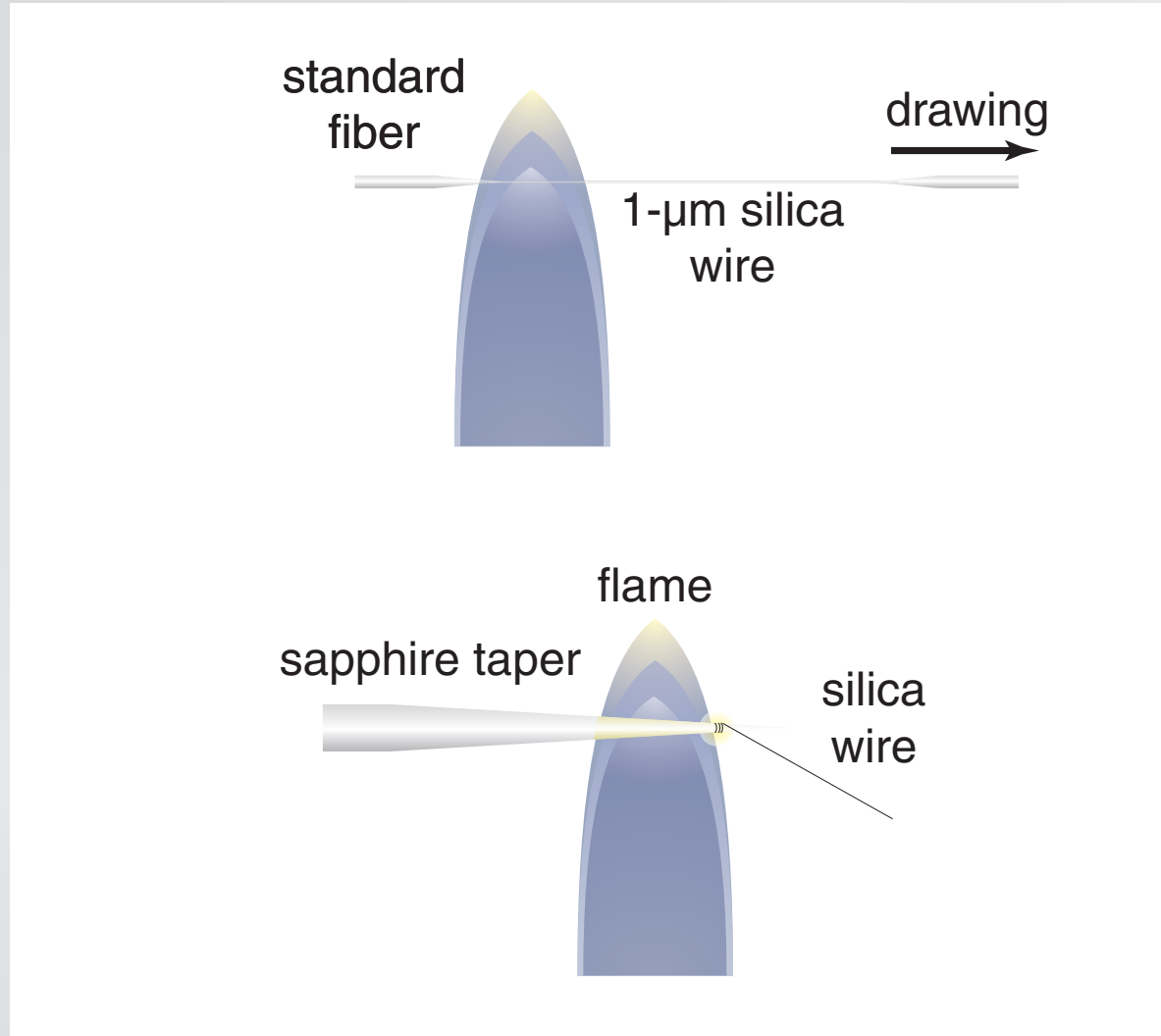
# Nanowire fabrication

## two-step drawing process



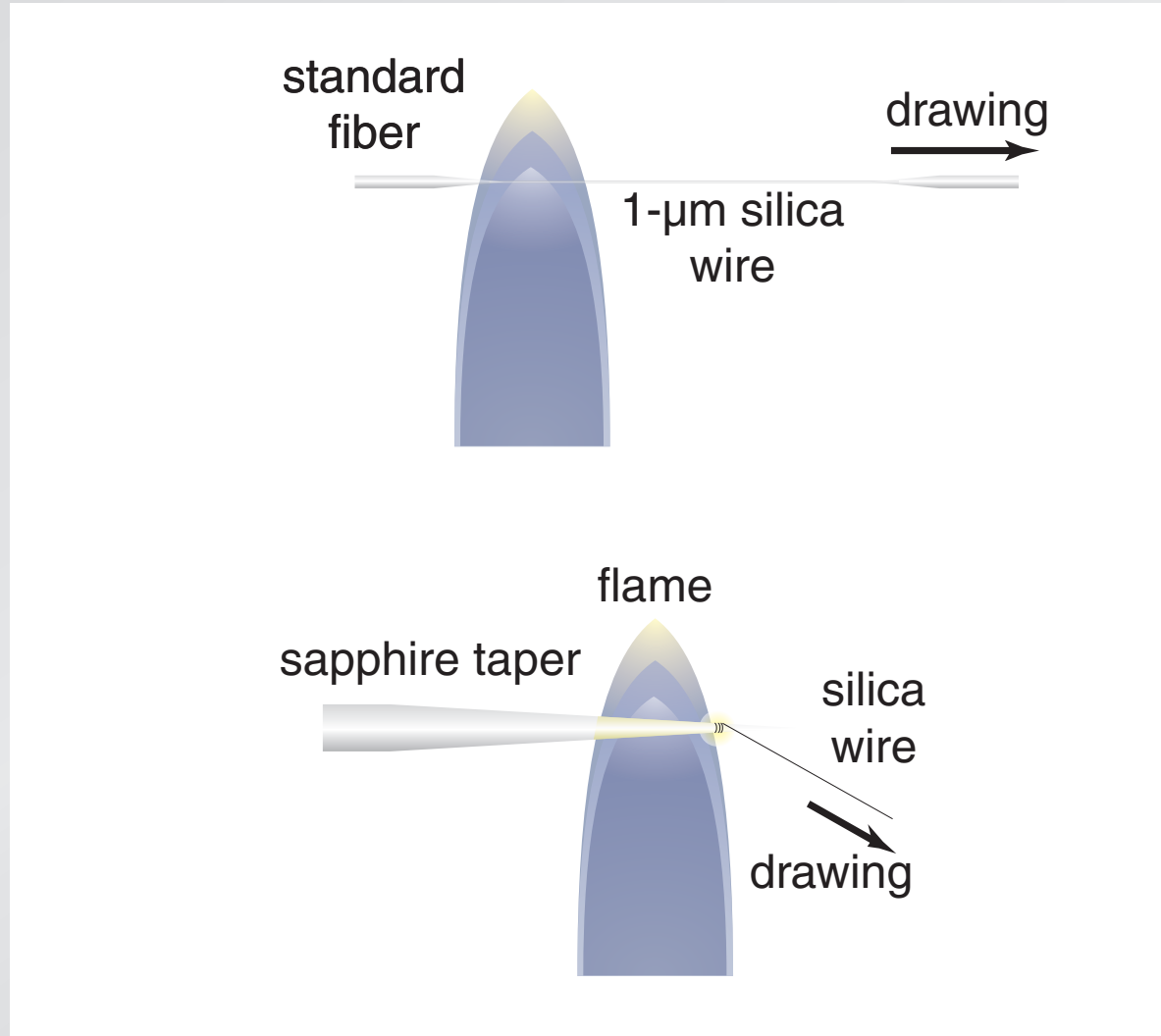
# Nanowire fabrication

## two-step drawing process



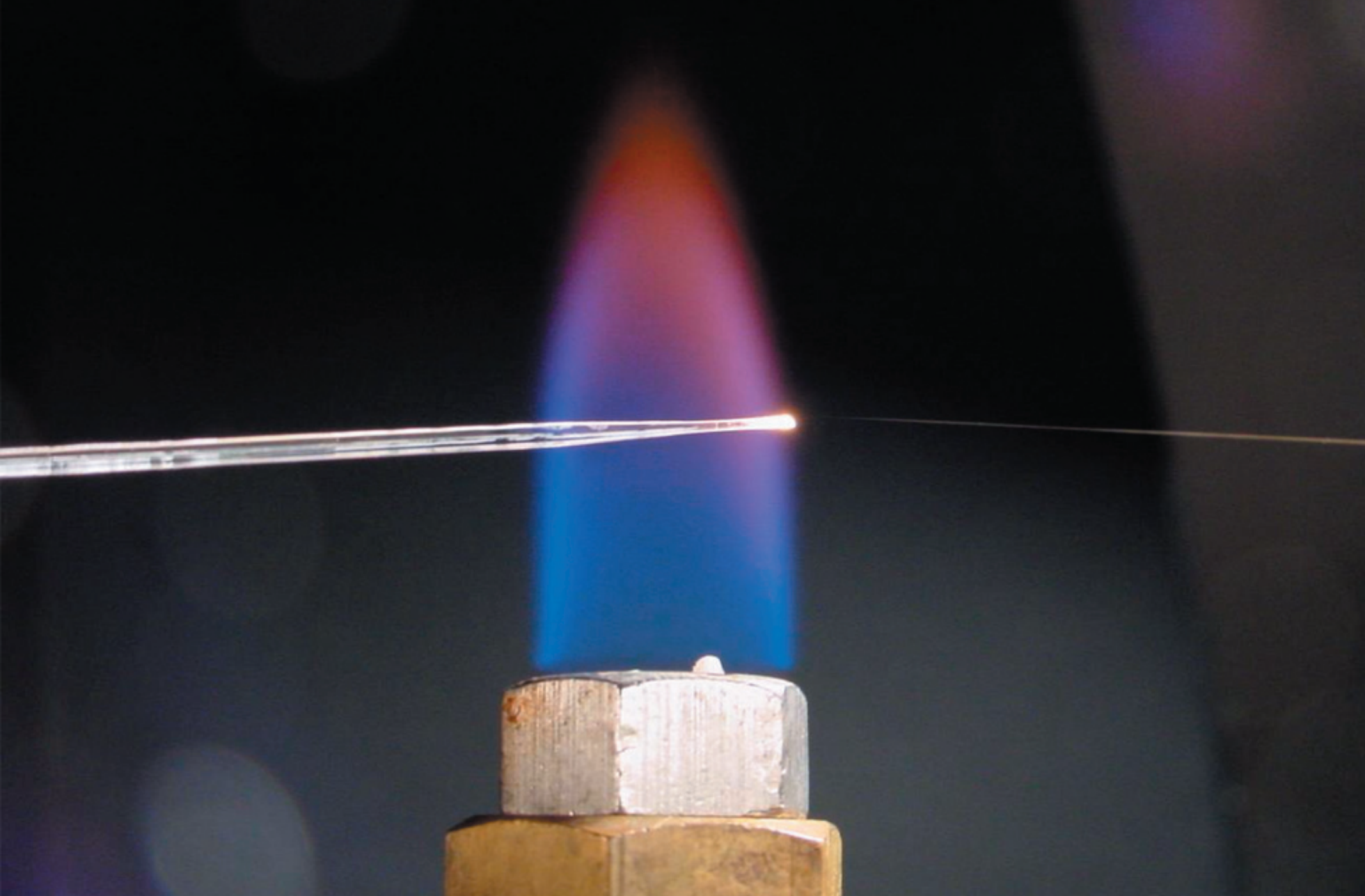
# Nanowire fabrication

## two-step drawing process





# Nanowire fabrication



# Nanowire fabrication

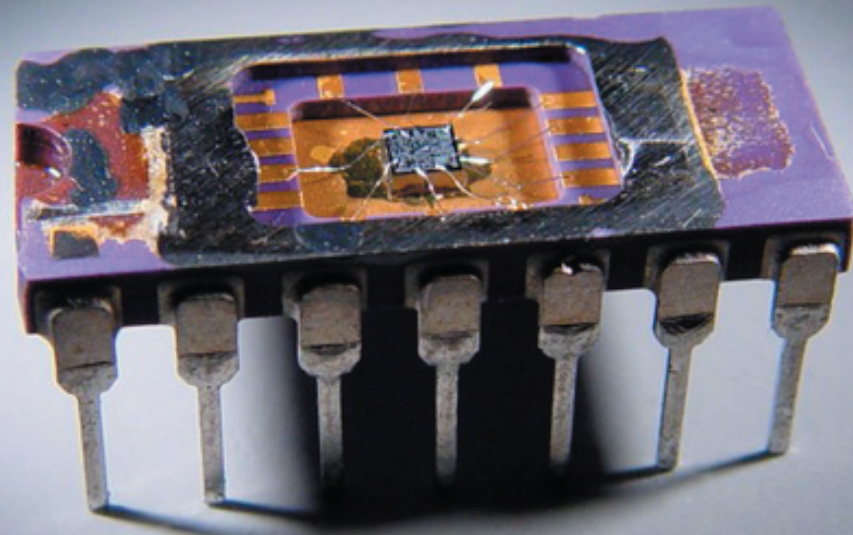
1  $\mu\text{m}$



*Nature*, 426, 816 (2003)

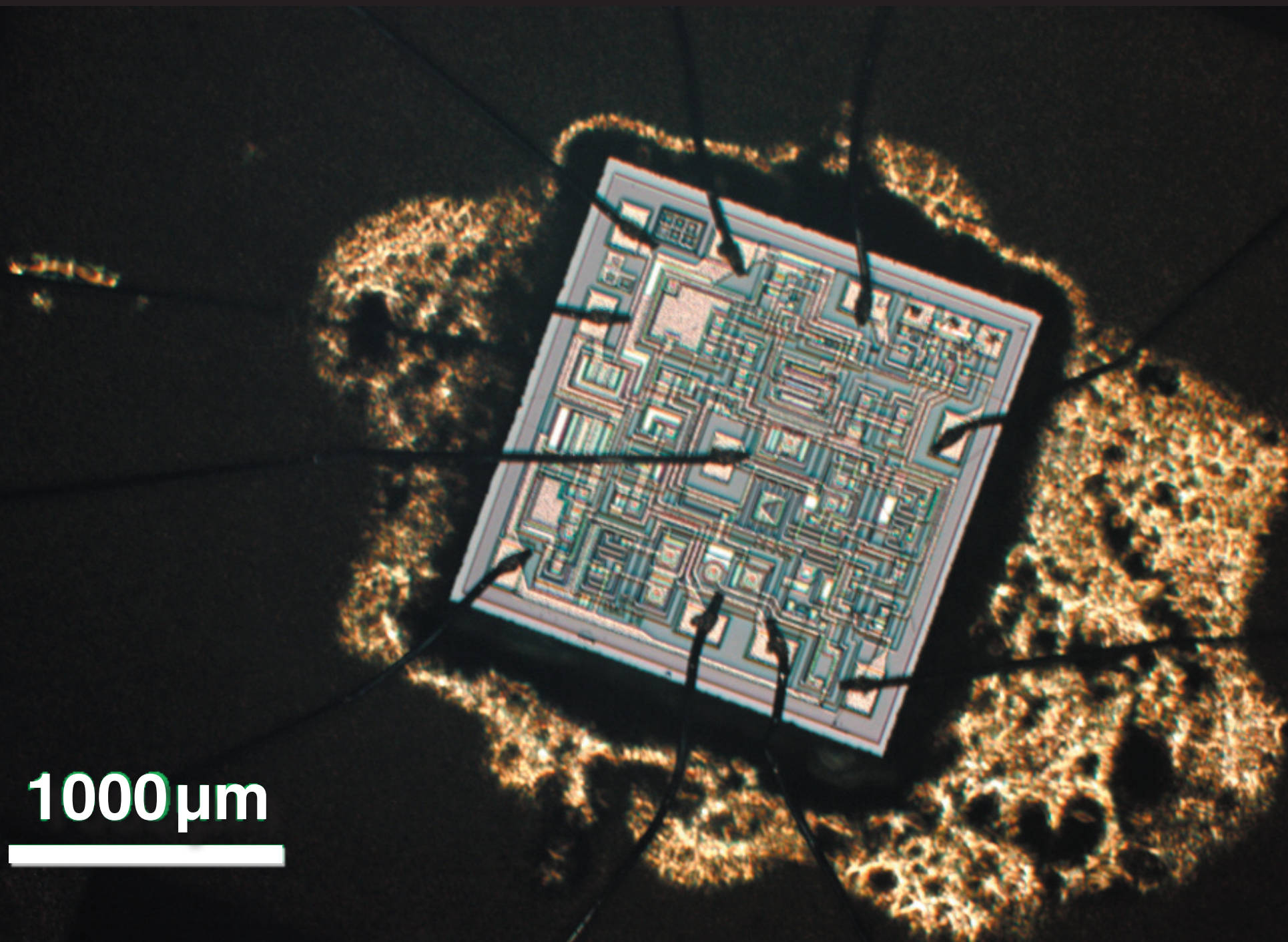


# Nanowire fabrication





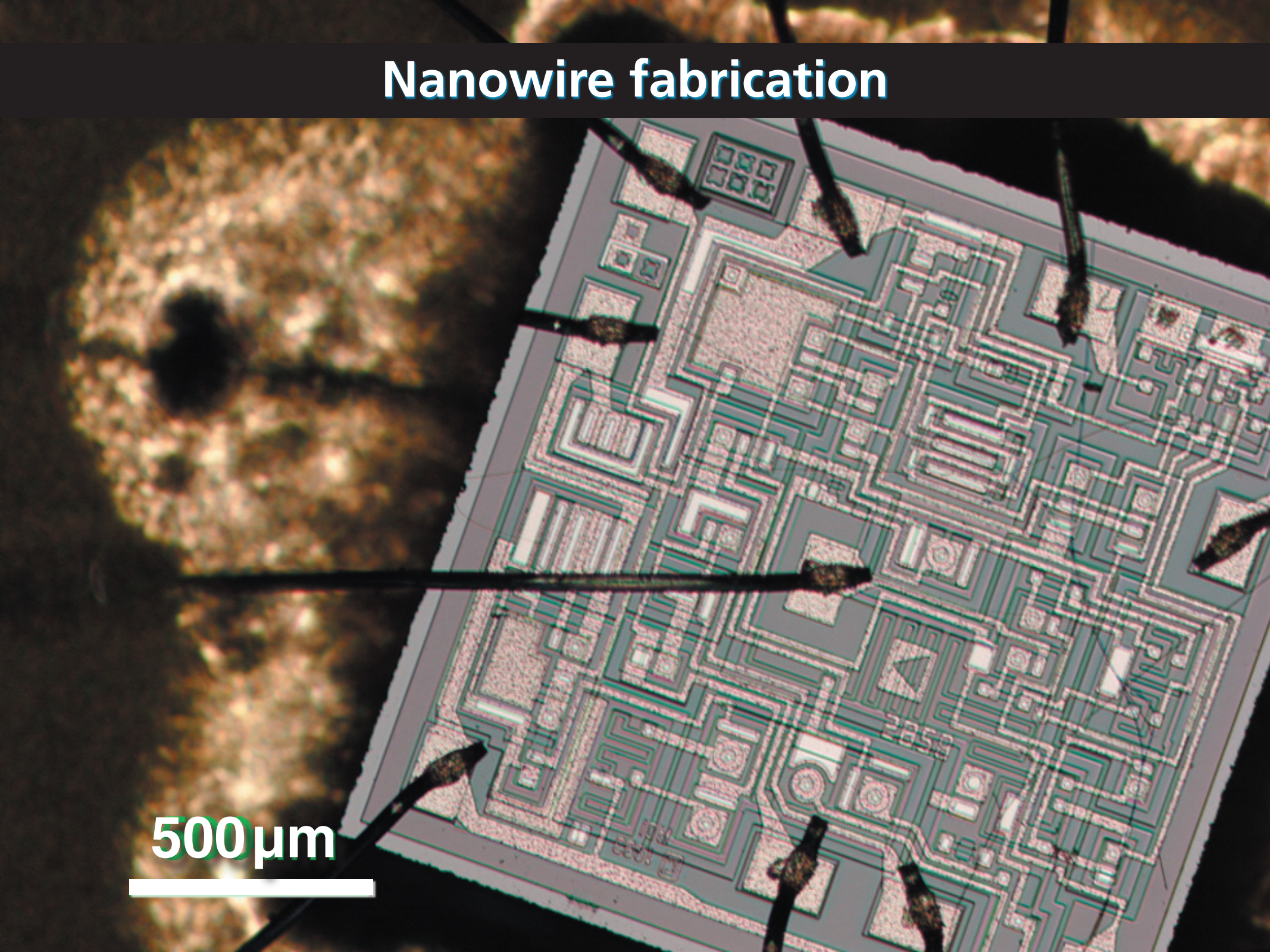
# Nanowire fabrication





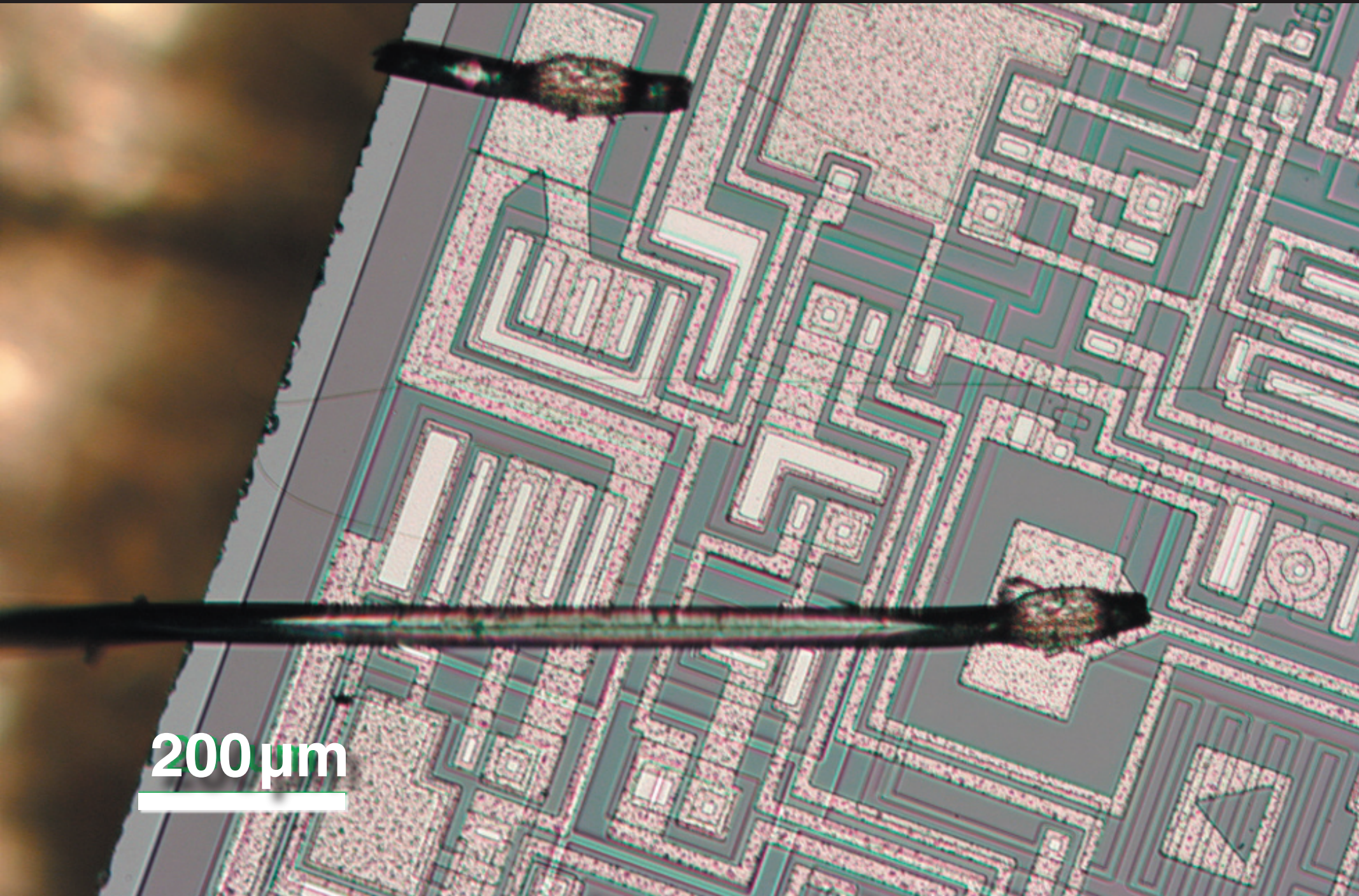
# Nanowire fabrication

500  $\mu\text{m}$





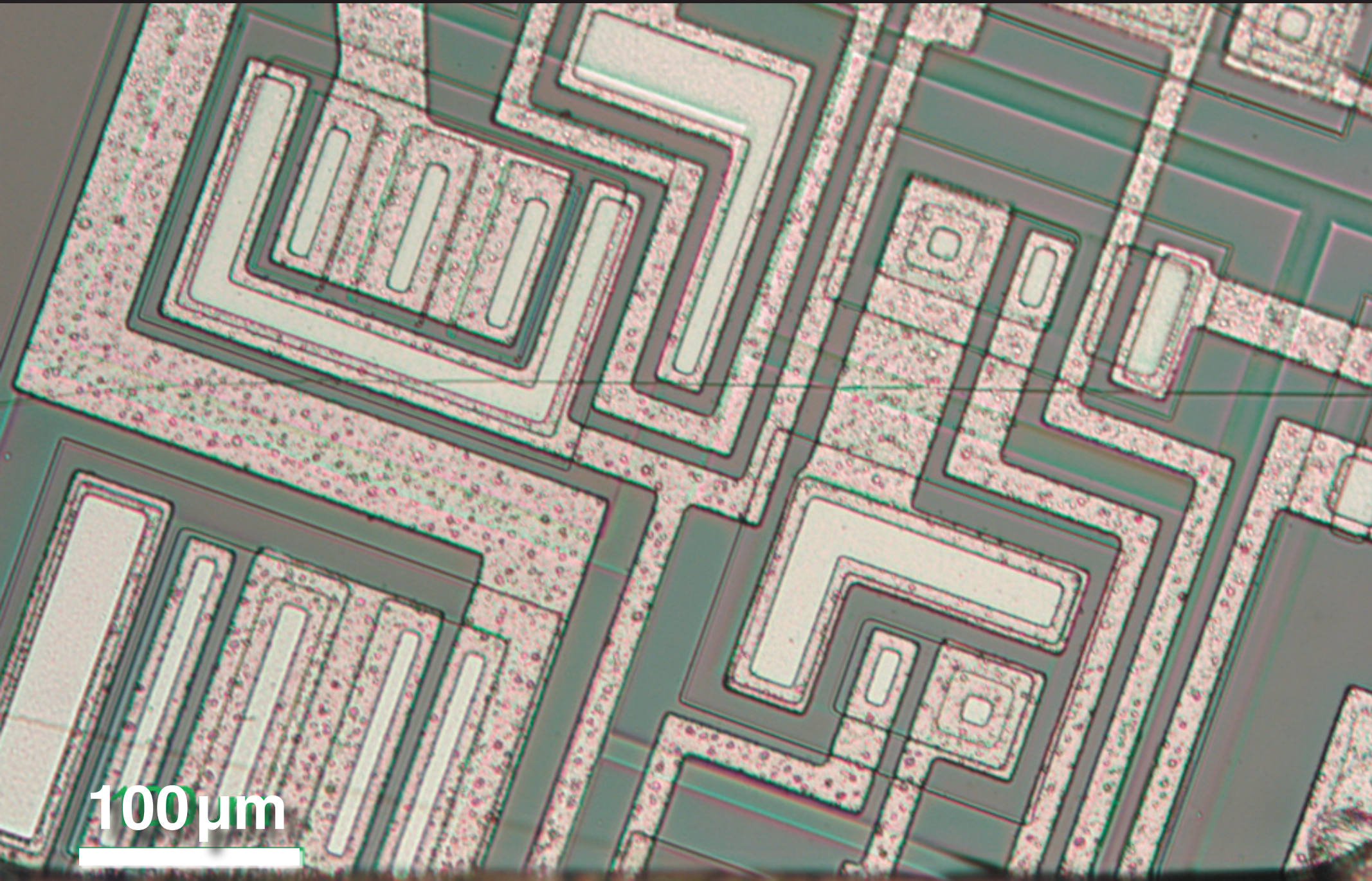
# Nanowire fabrication



200  $\mu\text{m}$



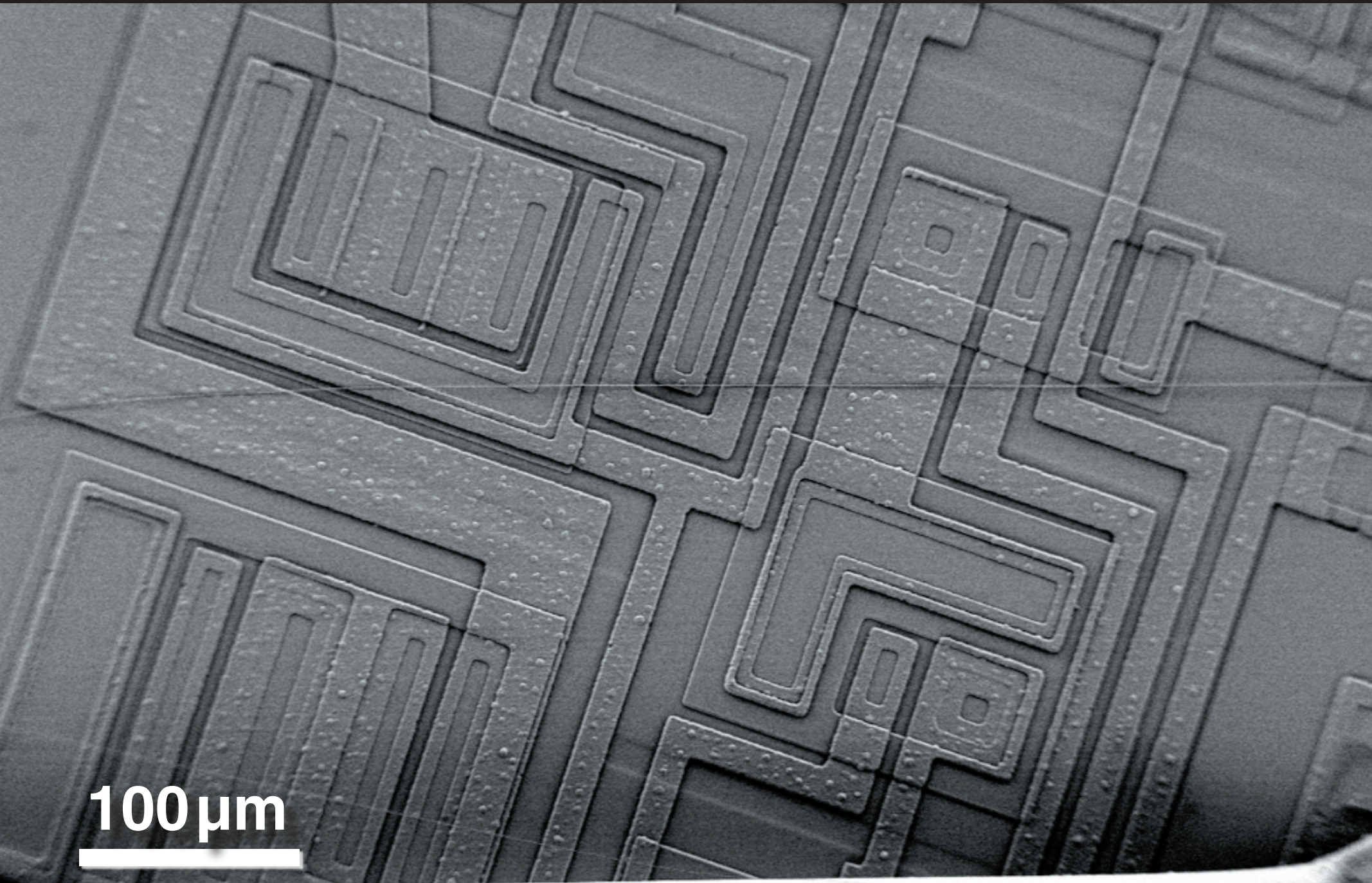
# Nanowire fabrication



100  $\mu\text{m}$



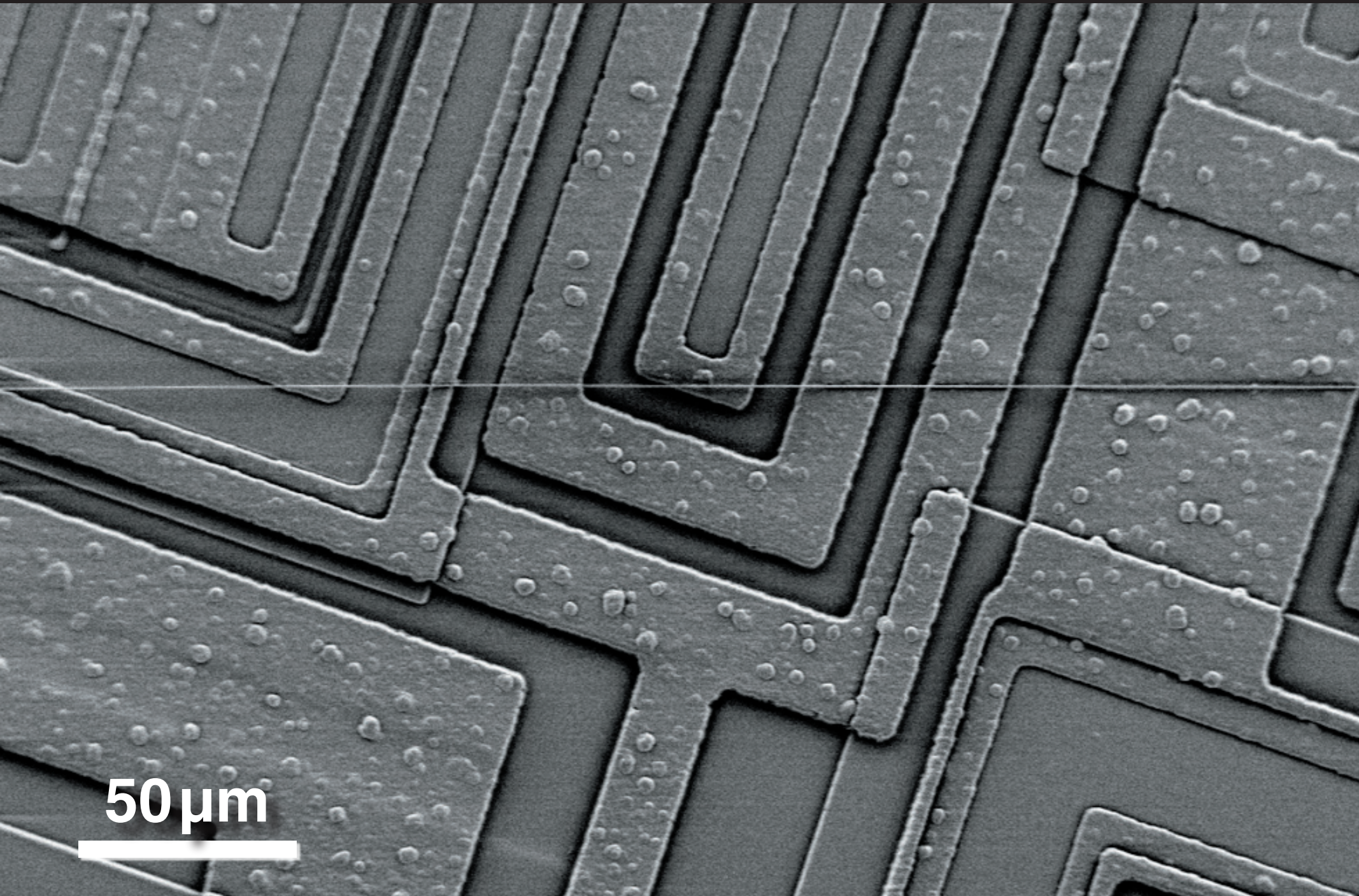
# Nanowire fabrication



100  $\mu\text{m}$



# Nanowire fabrication

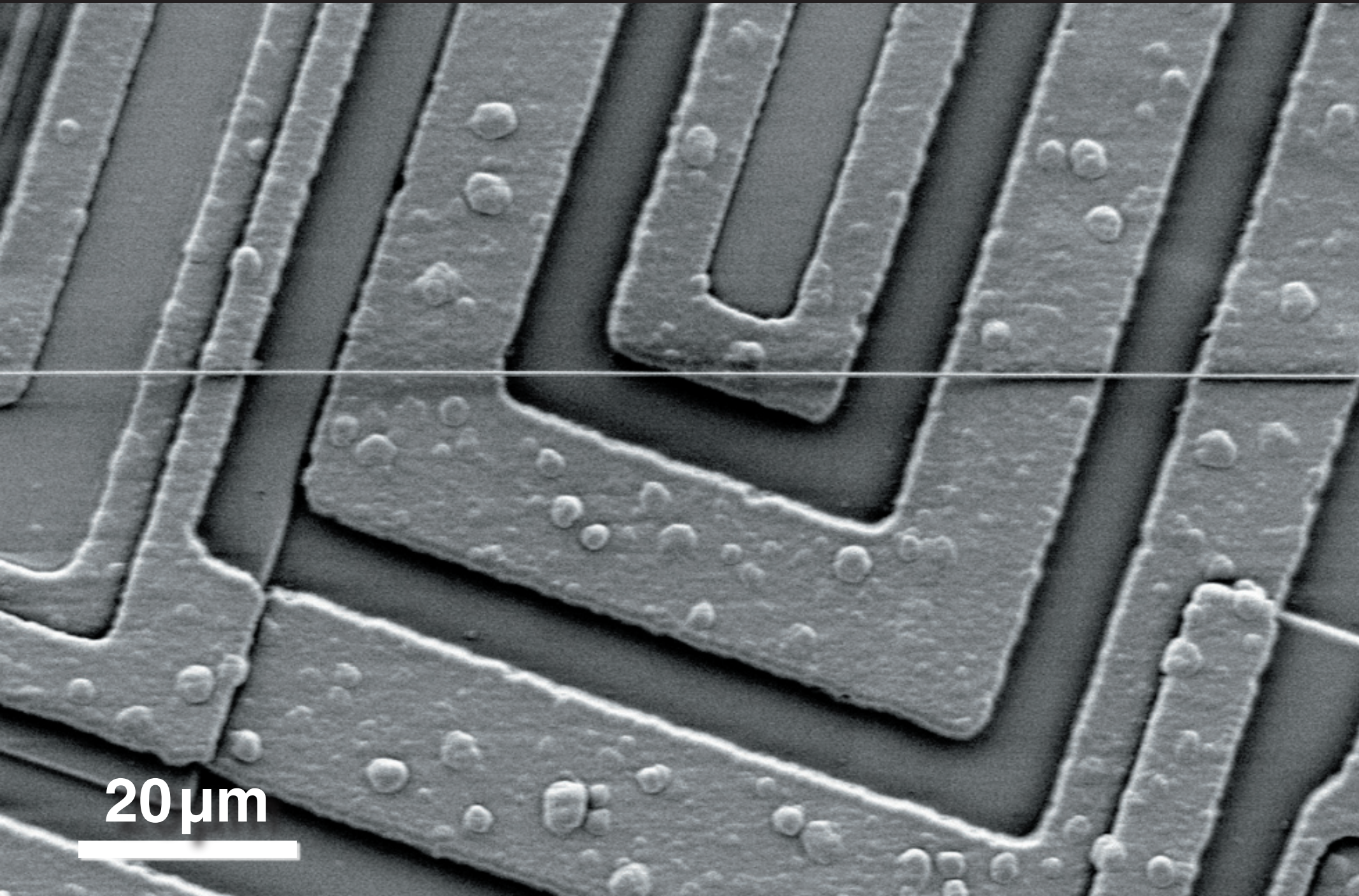


50  $\mu\text{m}$





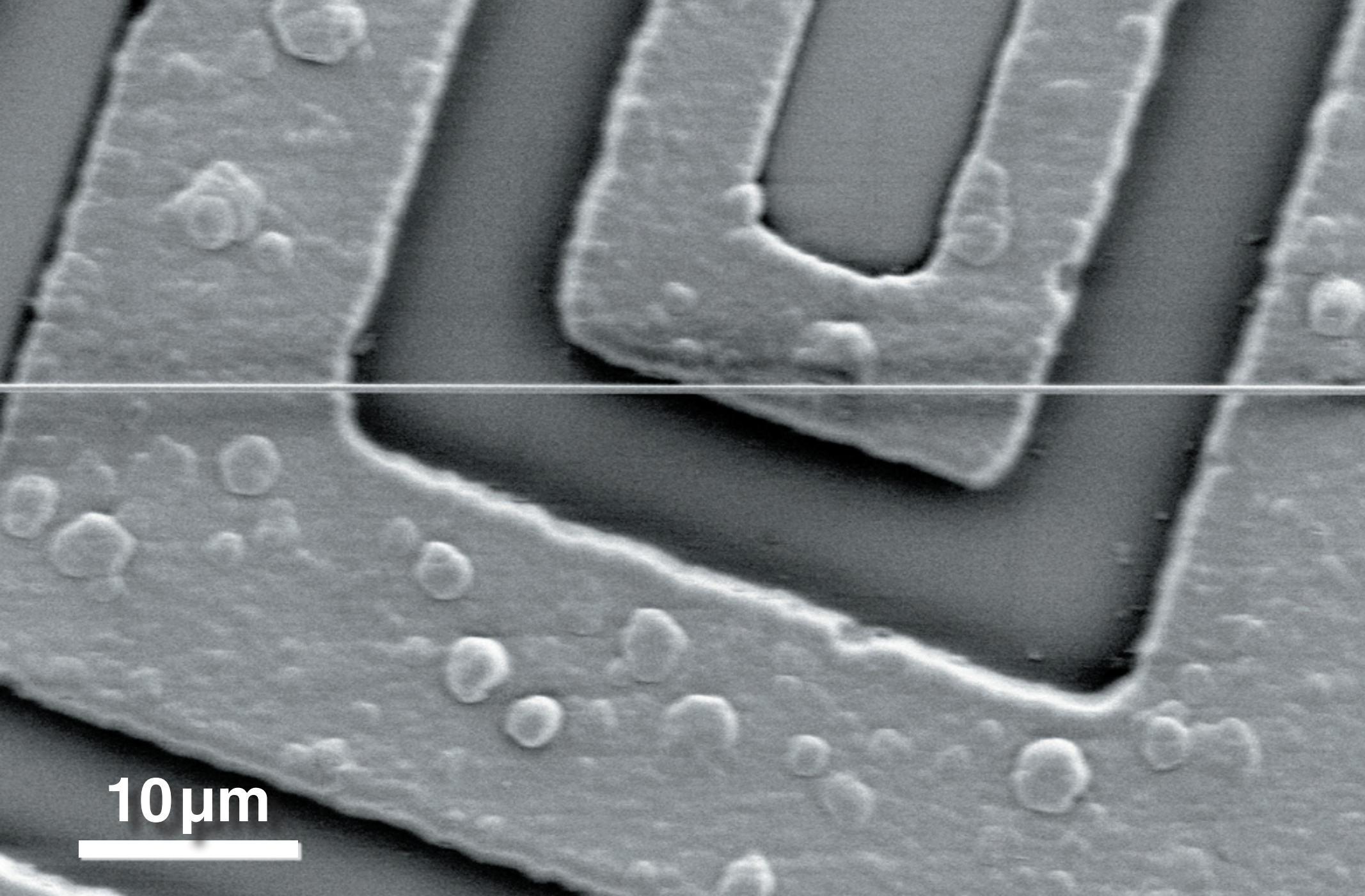
# Nanowire fabrication



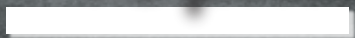
20  $\mu\text{m}$



# Nanowire fabrication

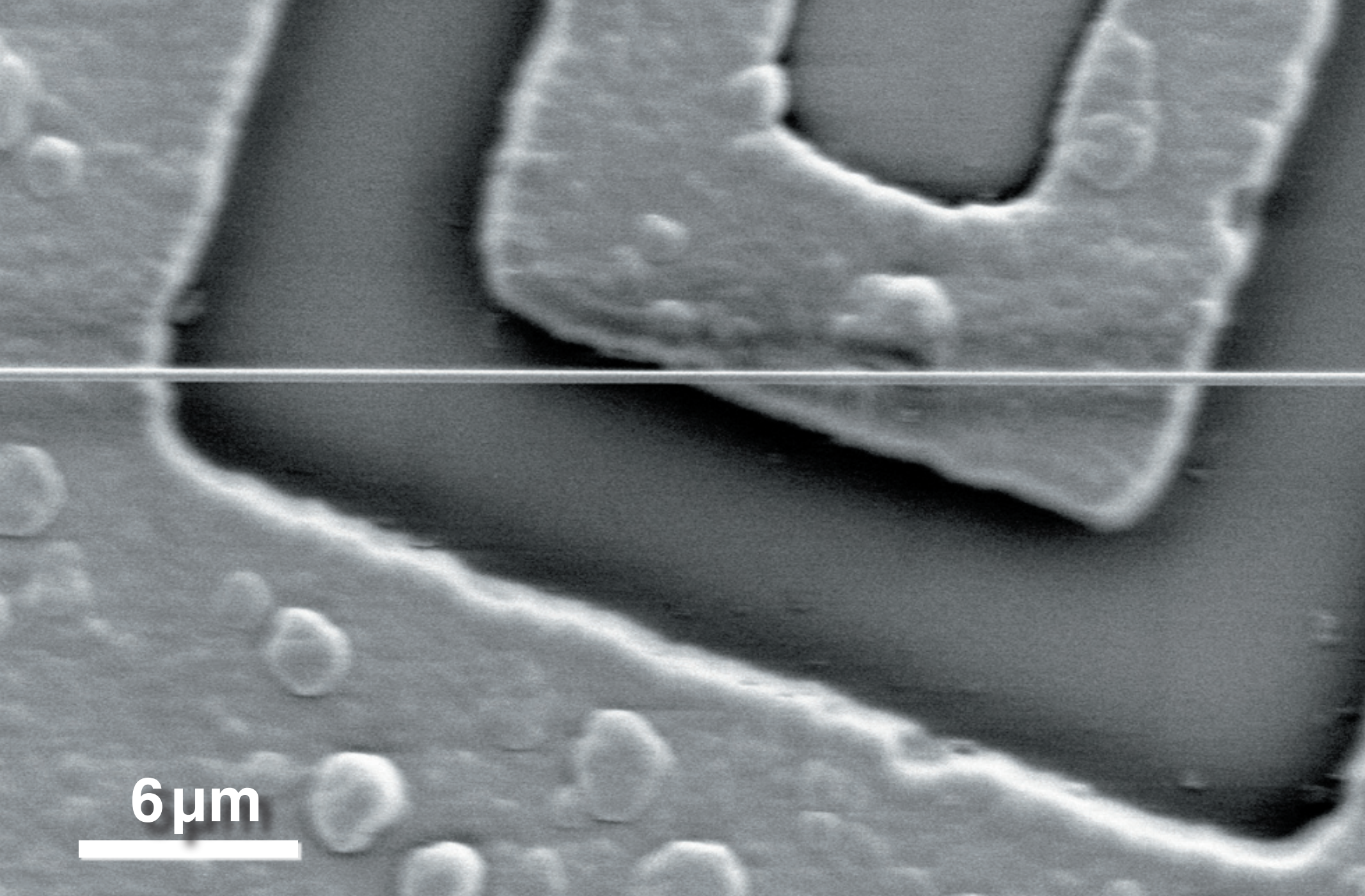


10  $\mu\text{m}$





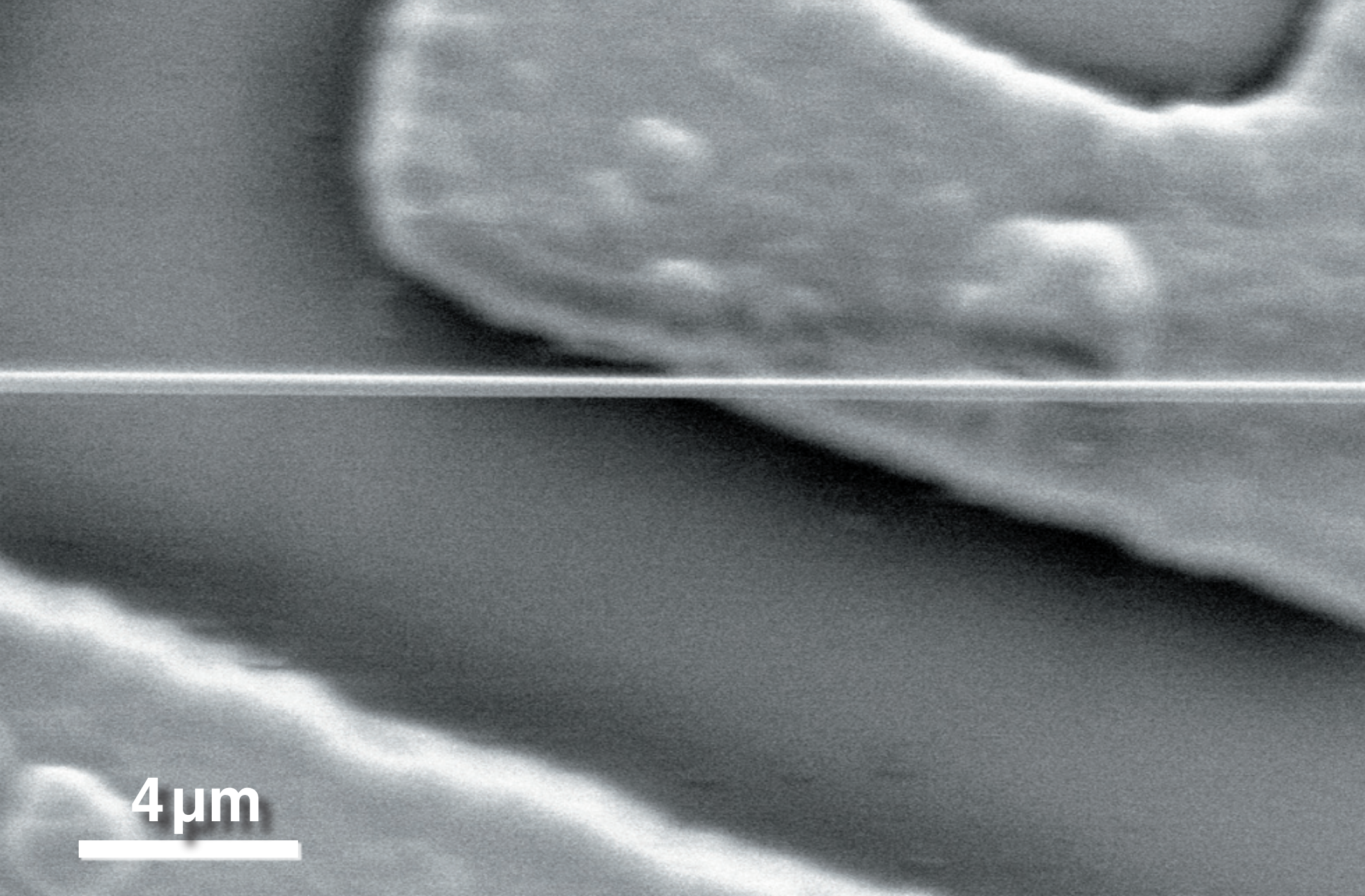
# Nanowire fabrication



6 μm



# Nanowire fabrication

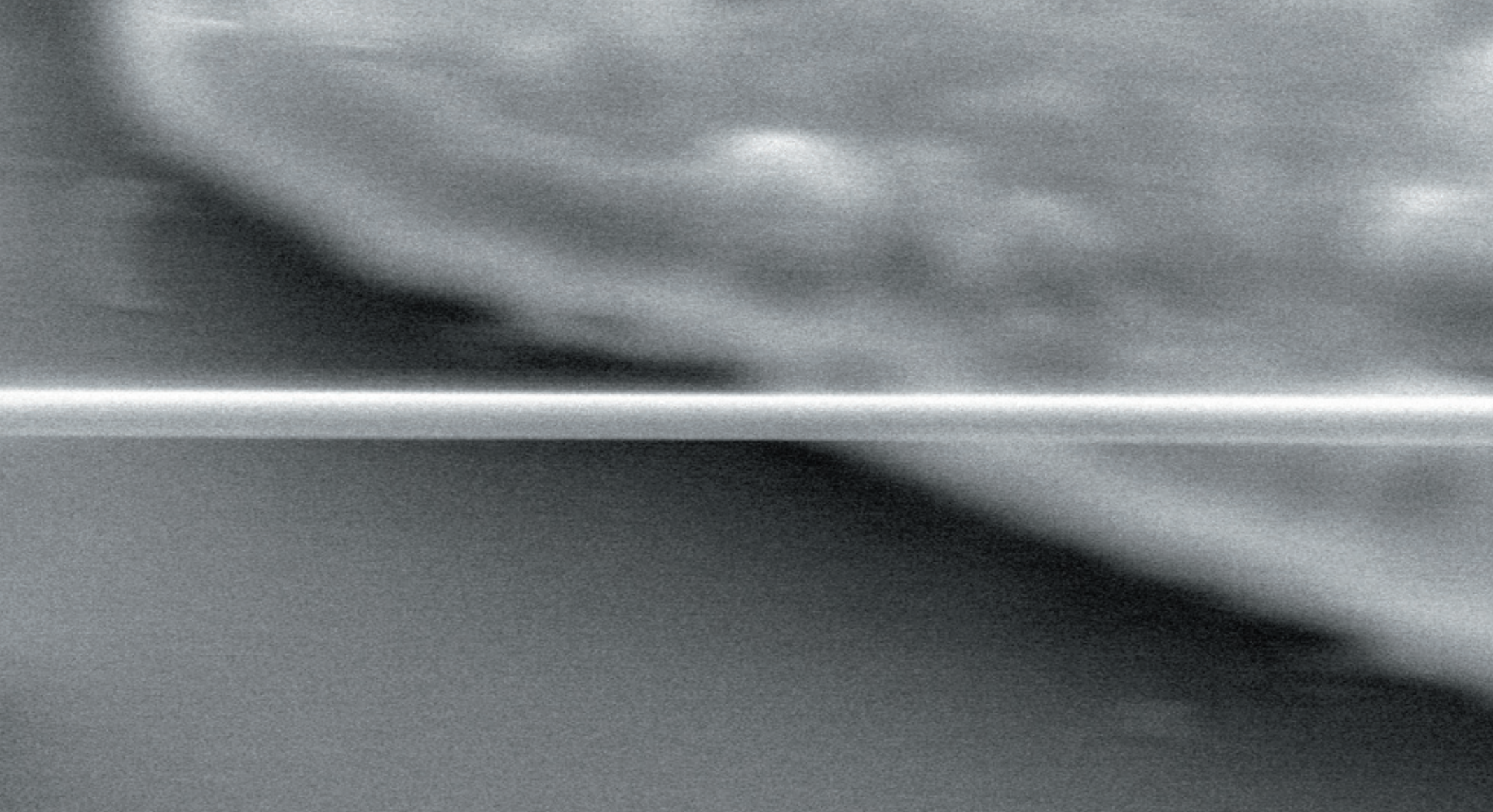


4  $\mu\text{m}$

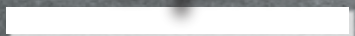




# Nanowire fabrication



2  $\mu\text{m}$





# Nanowire fabrication

312 nm

A transmission electron micrograph (TEM) showing a single, long, cylindrical nanowire. The nanowire is oriented horizontally and has a uniform diameter. A vertical white line with a crossbar at the center of the nanowire indicates its diameter, which is labeled as 312 nm. The background is dark and grainy, typical of a TEM image.

1  $\mu\text{m}$

A horizontal white scale bar located in the bottom left corner of the image, representing a length of 1 micrometer.



# Waveguiding

## Specifications

diameter  $D$ : down to 20 nm

length  $L$ : up to 90 mm

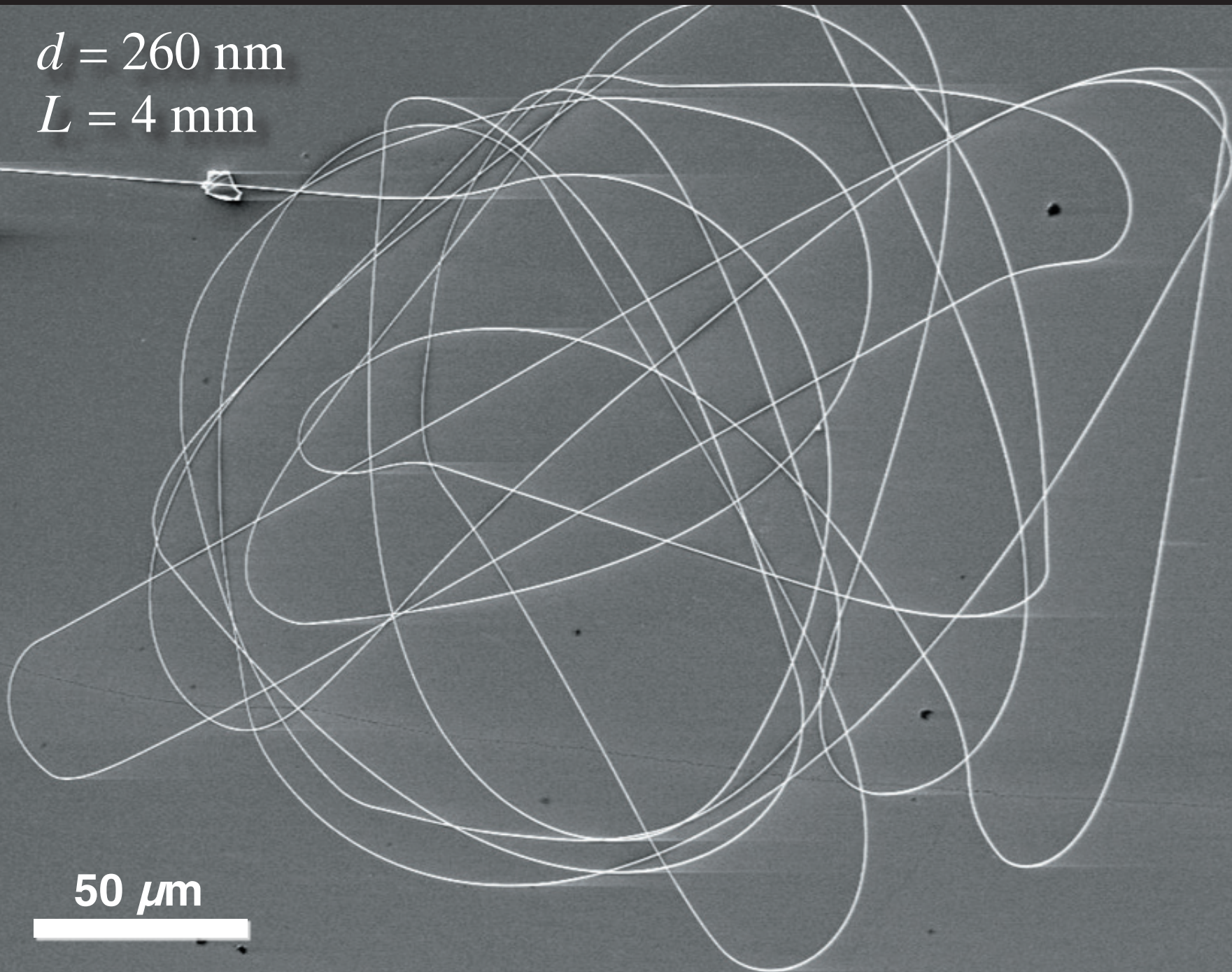
aspect ratio  $D/L$ : up to  $10^6$

diameter uniformity  $\Delta D/L$ :  $2 \times 10^{-6}$

# Nanowire fabrication

$d = 260 \text{ nm}$

$L = 4 \text{ mm}$



50  $\mu\text{m}$



# Nanowire fabrication

240-nm wire

200 nm



# Nanowire fabrication

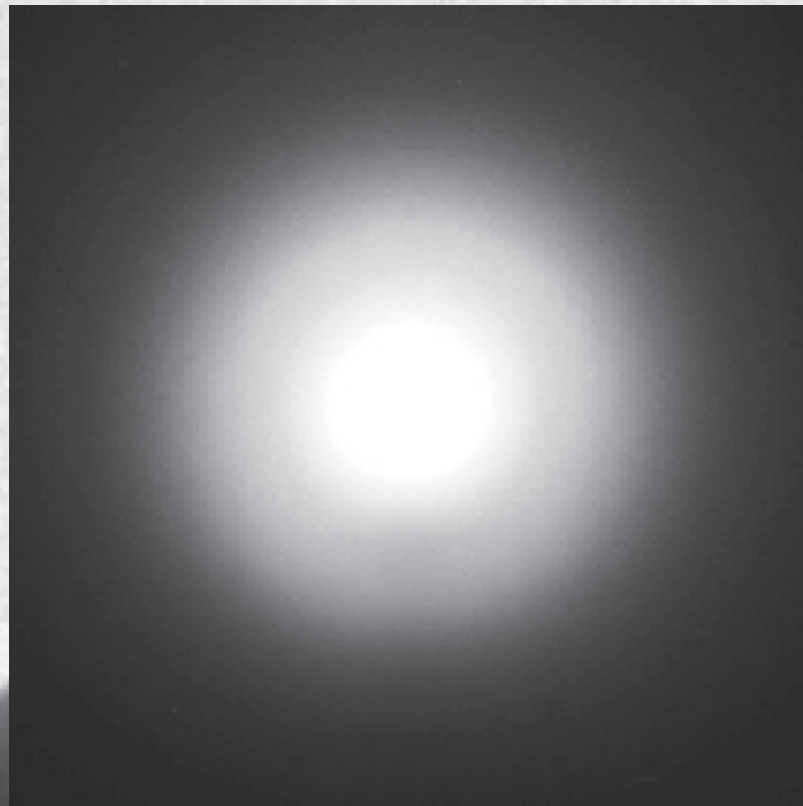
RMS roughness  $< 0.5$  nm

20 nm





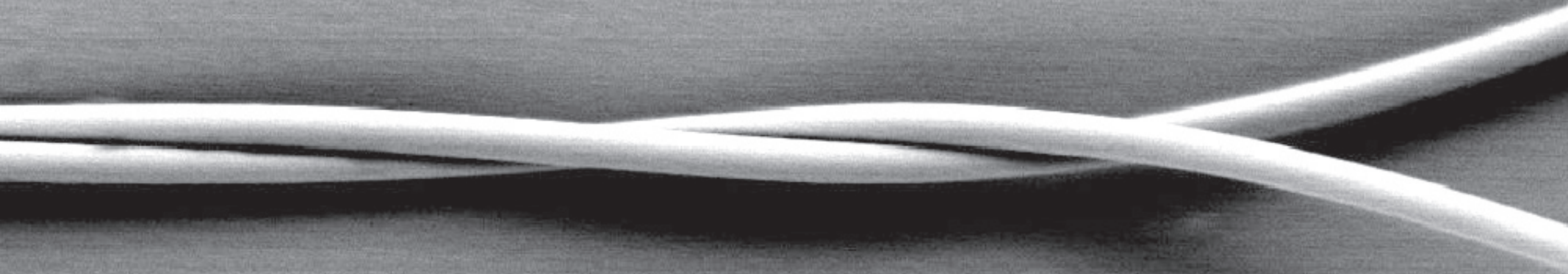
# Nanowire fabrication



20 nm



# Nanowire fabrication

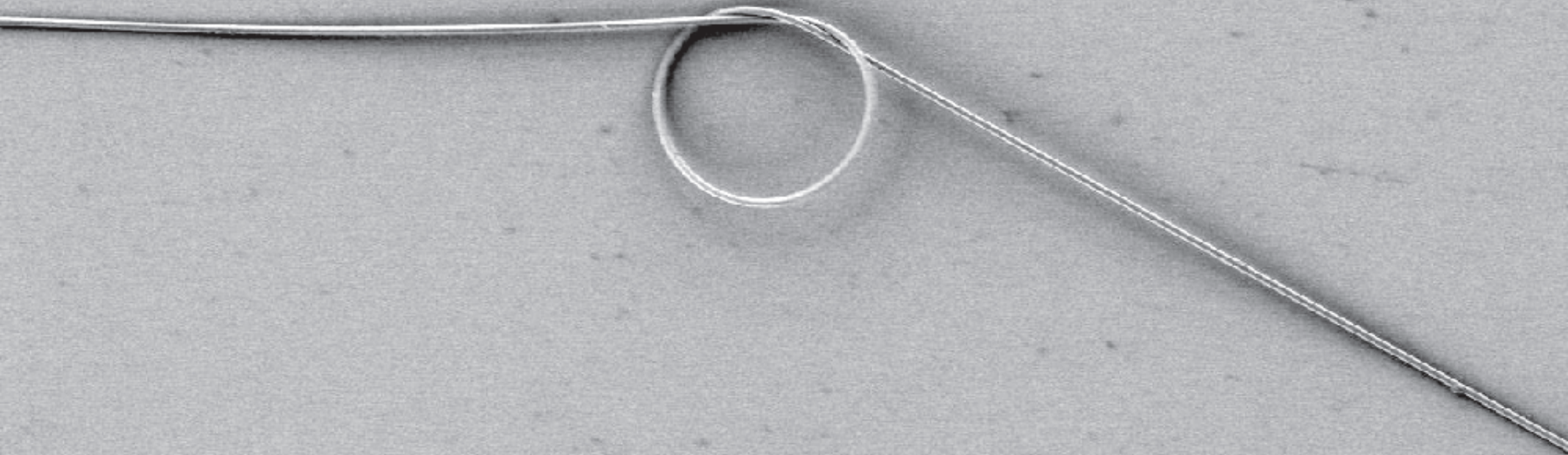


2  $\mu\text{m}$

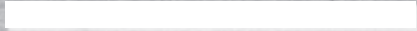




# Nanowire fabrication

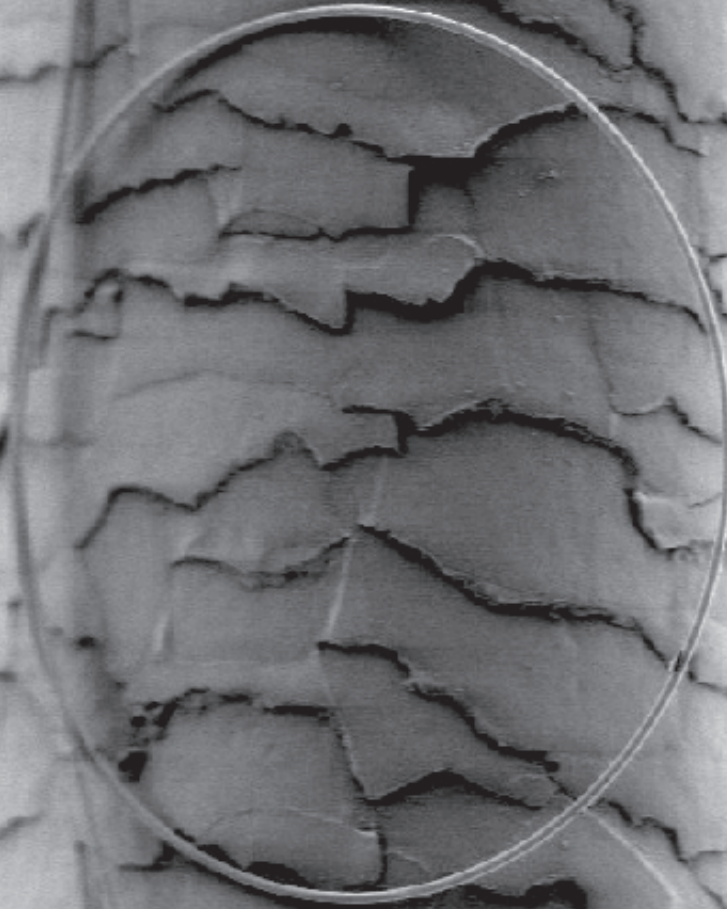


20  $\mu\text{m}$





# Nanowire fabrication



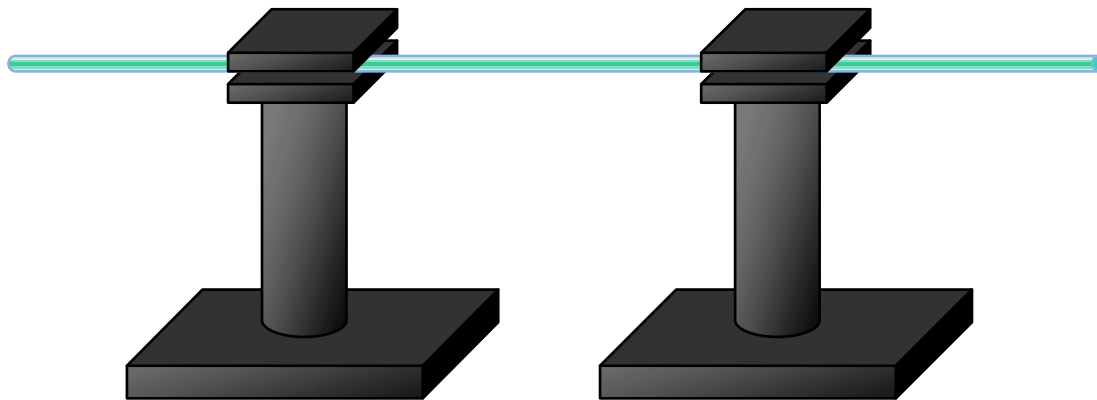
20  $\mu\text{m}$





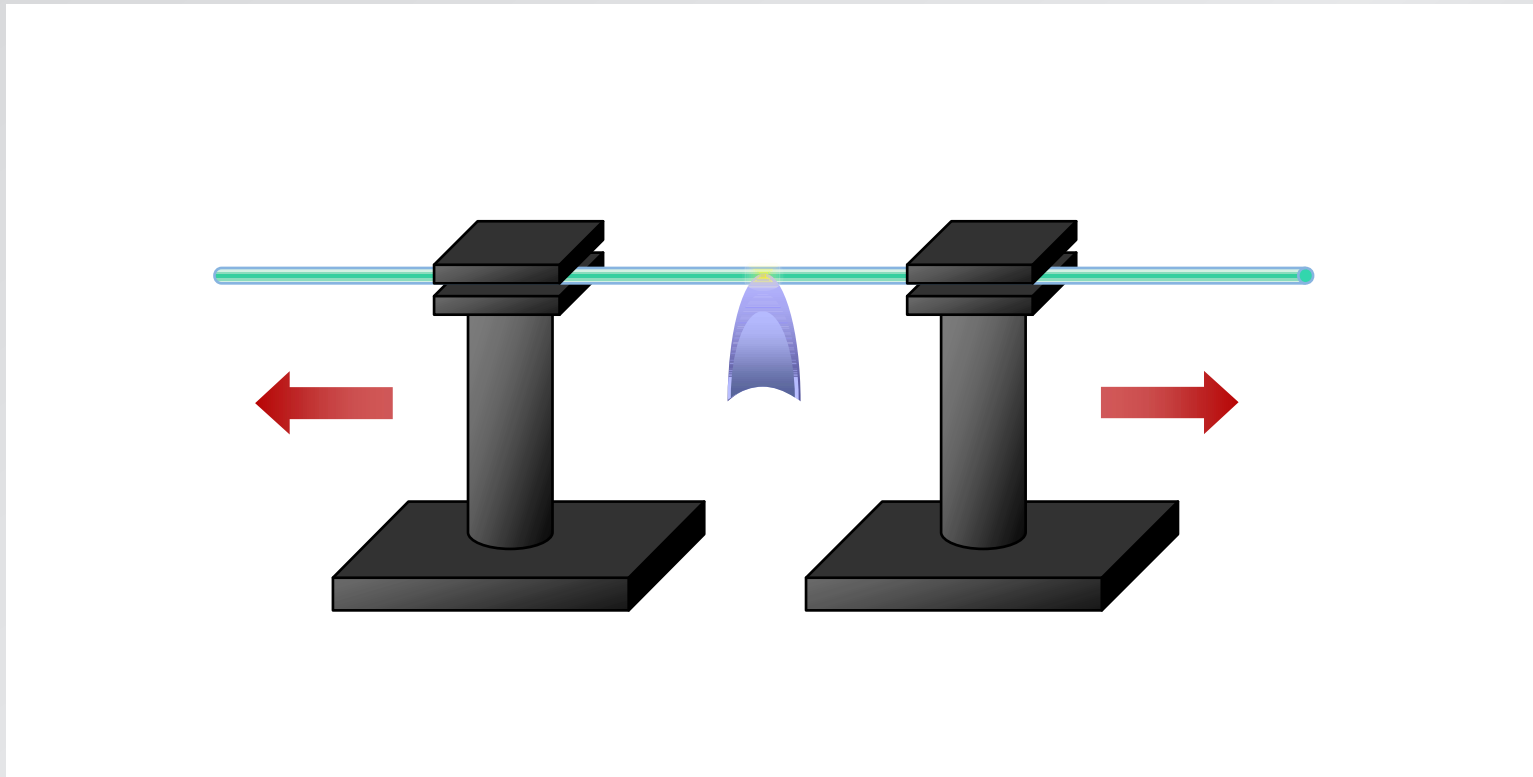
# Silica nanowires

automated drawing process



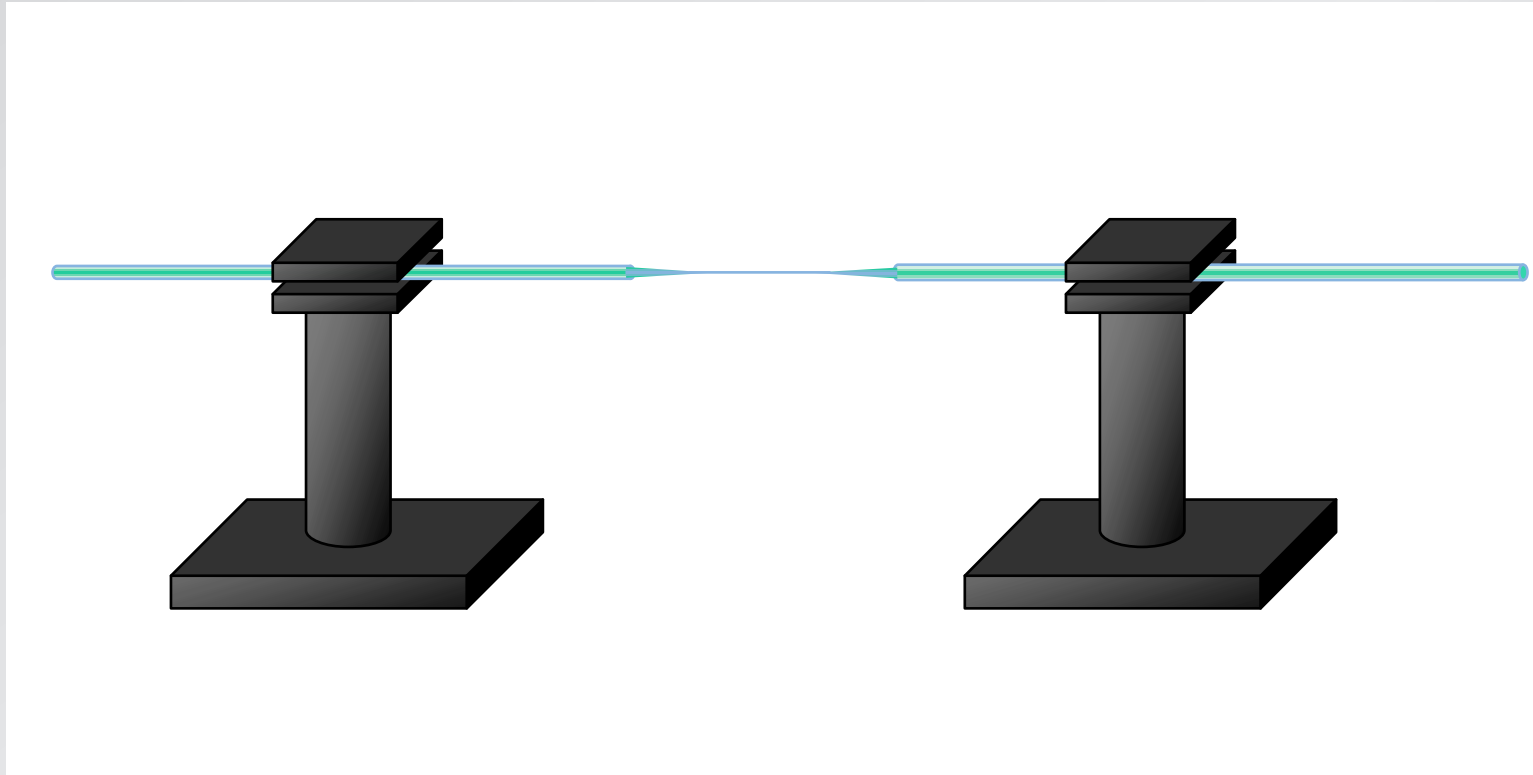
# Silica nanowires

automated drawing process



# Silica nanowires

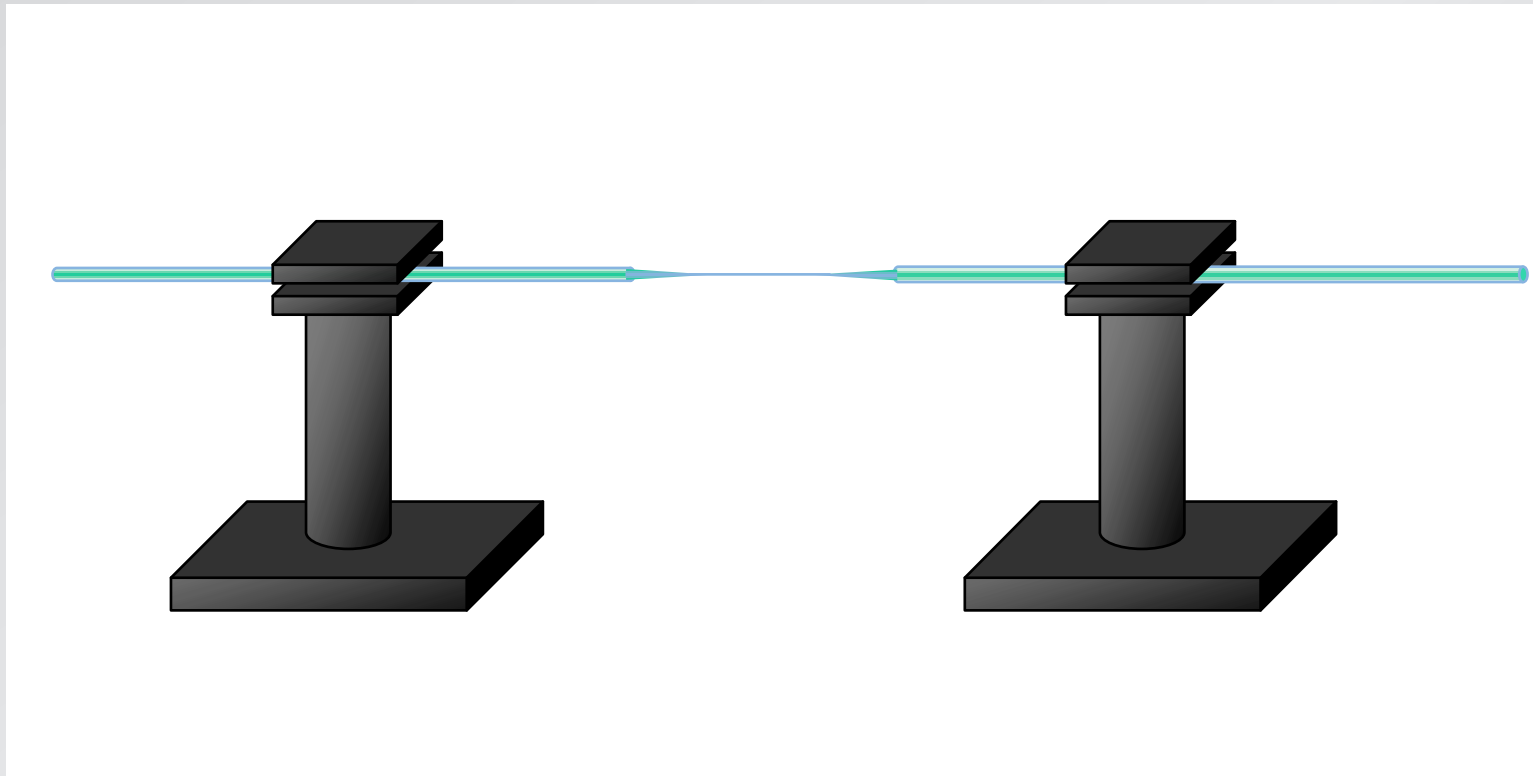
automated drawing process





# Silica nanowires

automated drawing process



advantage: tapers on both sides