

The background of the slide is a scanning electron microscope (SEM) image of black silicon. It shows a dense array of vertical, tapered silicon nanowires or pillars. Each pillar has a textured, porous surface and a rounded, hemispherical top. The pillars are arranged in a somewhat regular grid pattern, with some variations in height and width. The overall appearance is that of a highly structured, porous material.

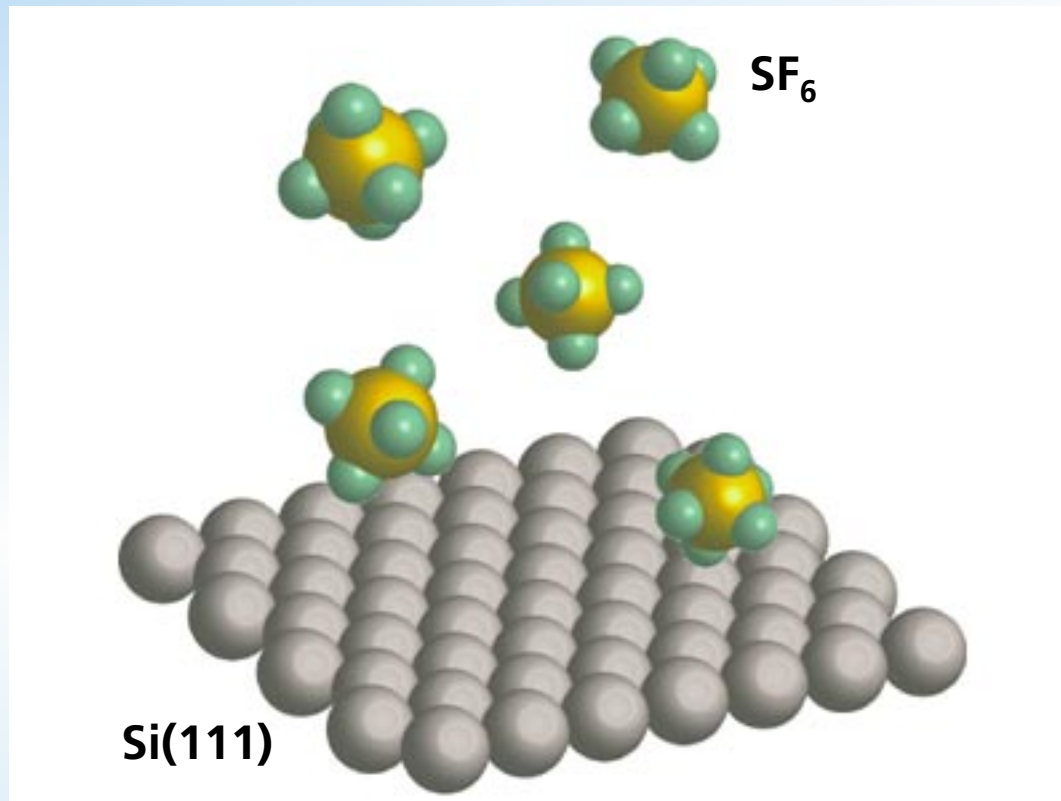
**BLACK SILICON:
microstructuring silicon with femtosecond lasers**

**Tsing-Hua Her
Claudia Wu
Jim Carey
Catherine Crouch
Li Zhao
Eric Mazur**

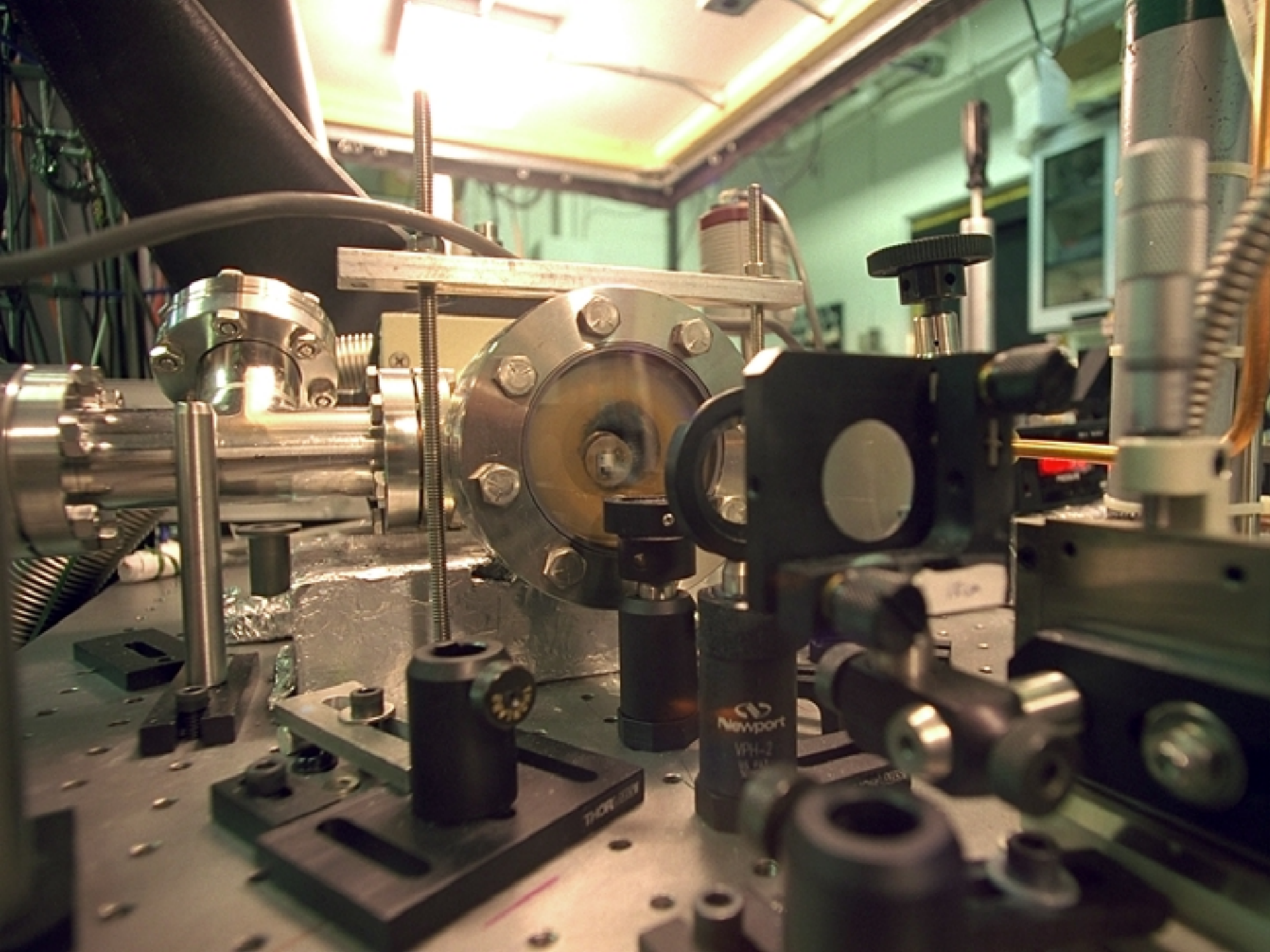
**MRS Spring Meeting
San Francisco, 17 April 2001**

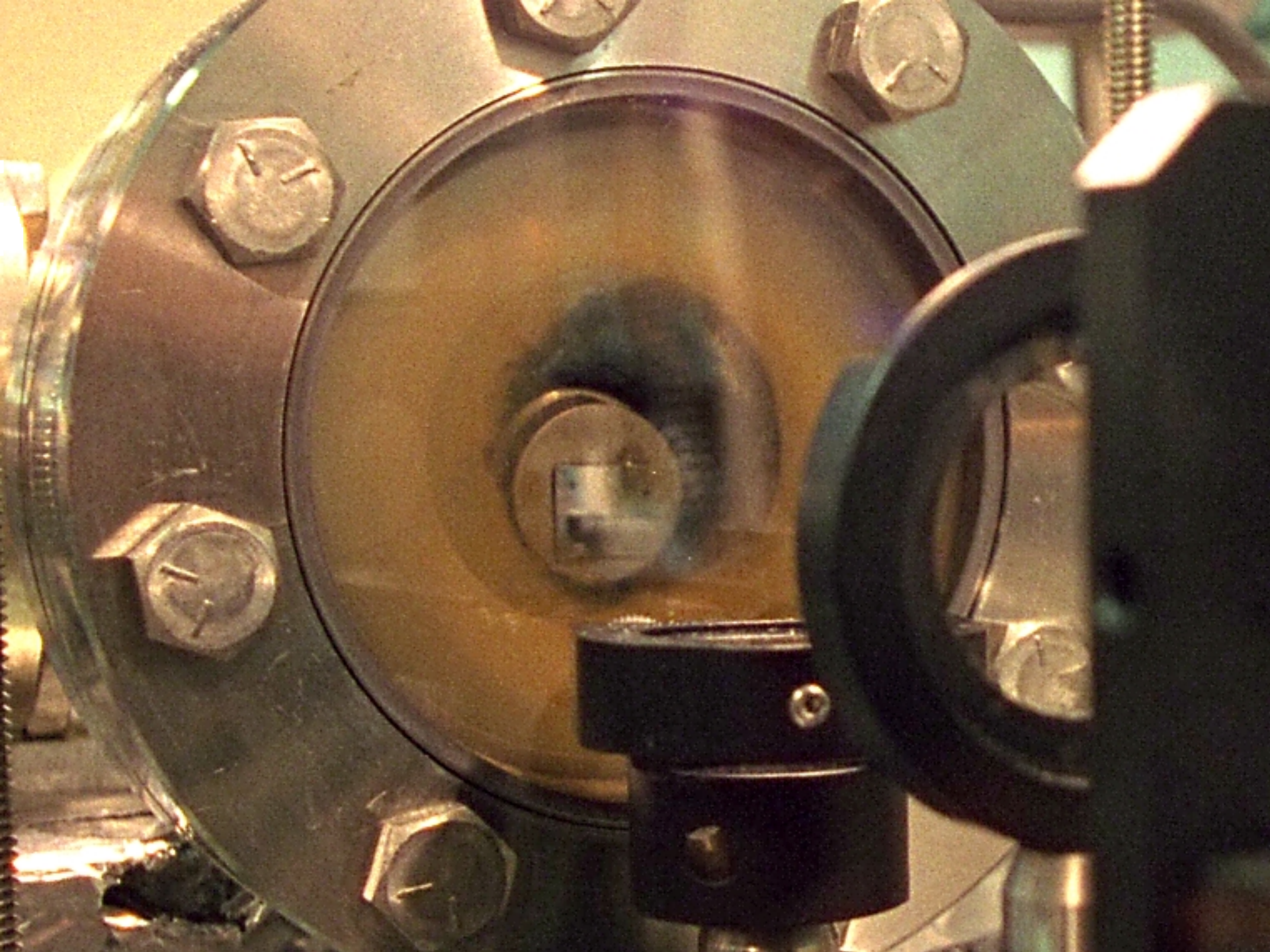


Introduction

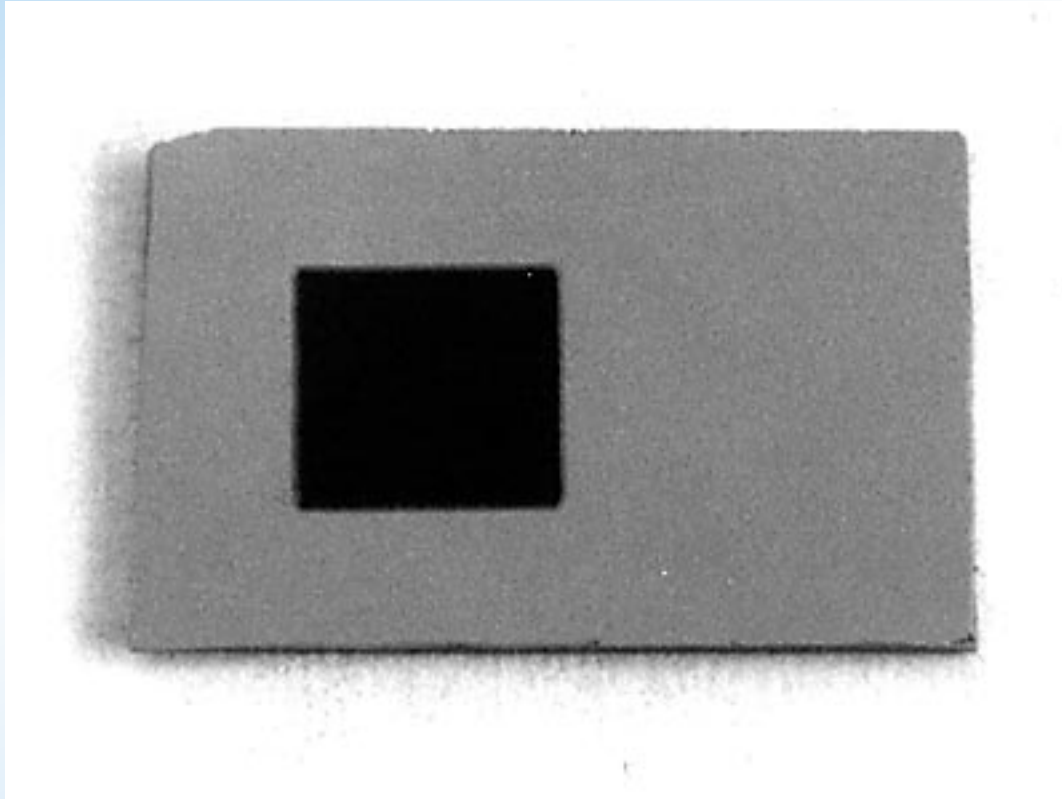


irradiate with 100 fs 10 kJ/m² laser pulses



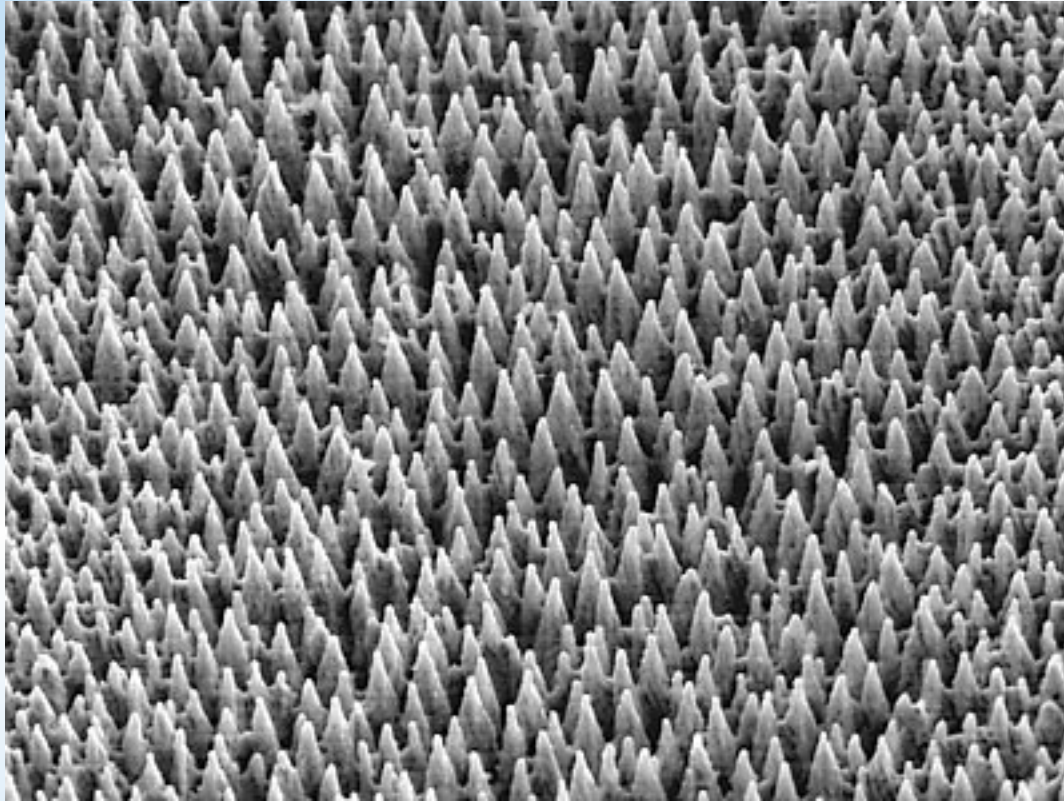


Introduction



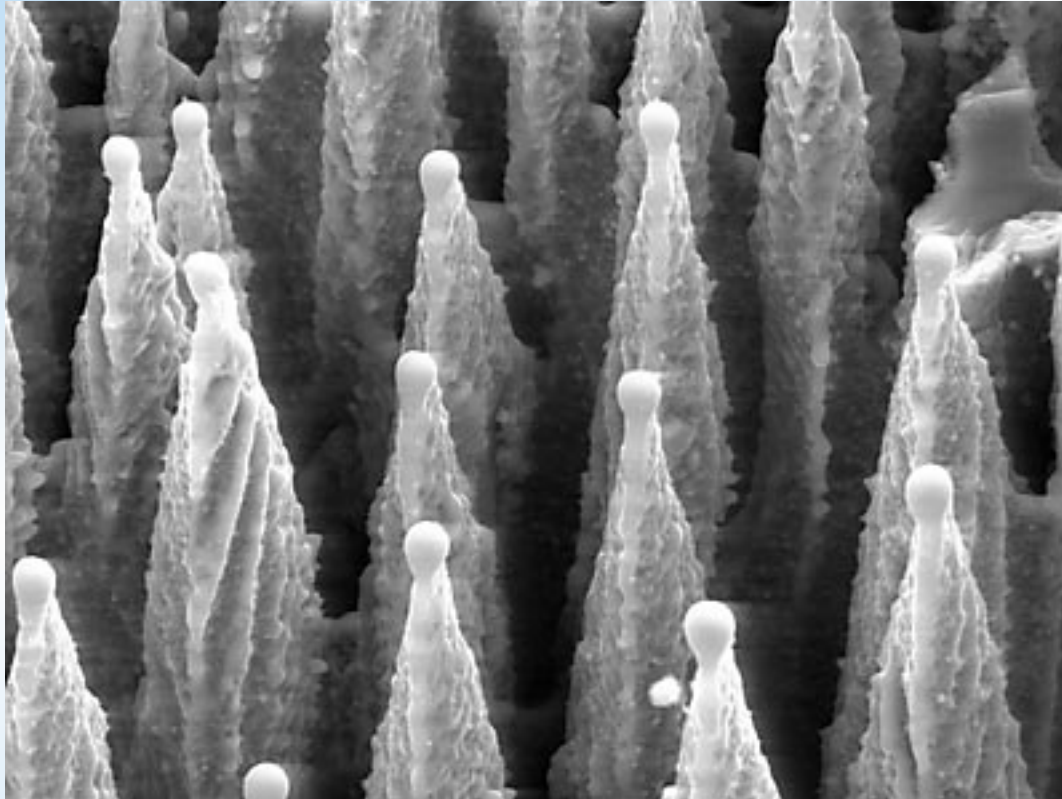
5 mm

Introduction



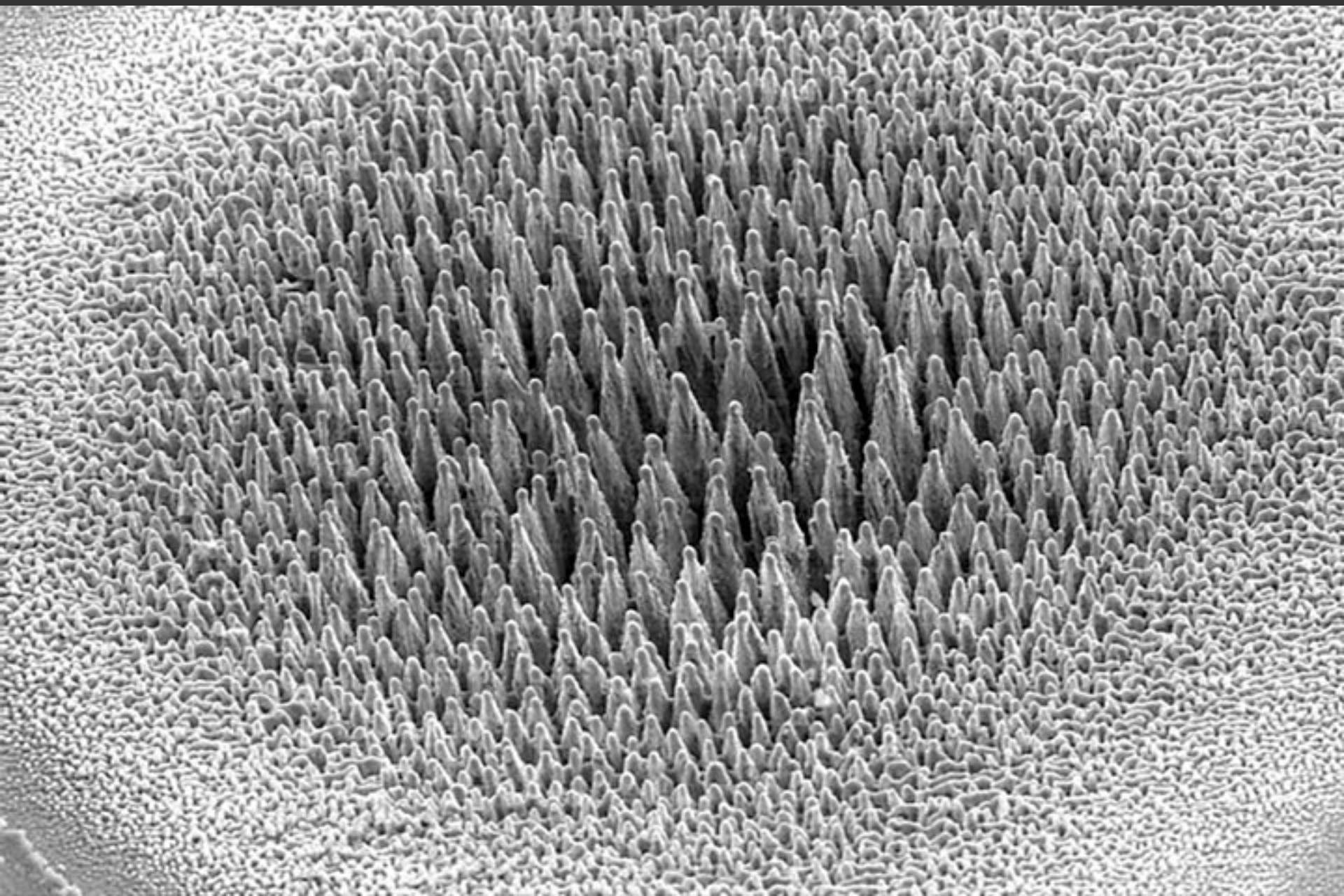
20 μm

Introduction

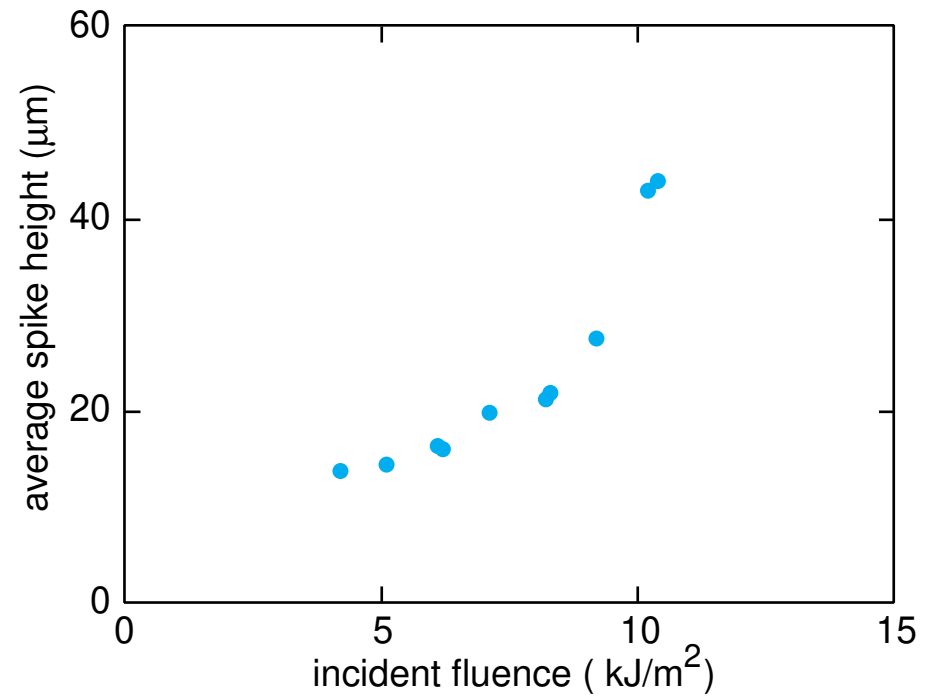


4 μm

Conditions for formation

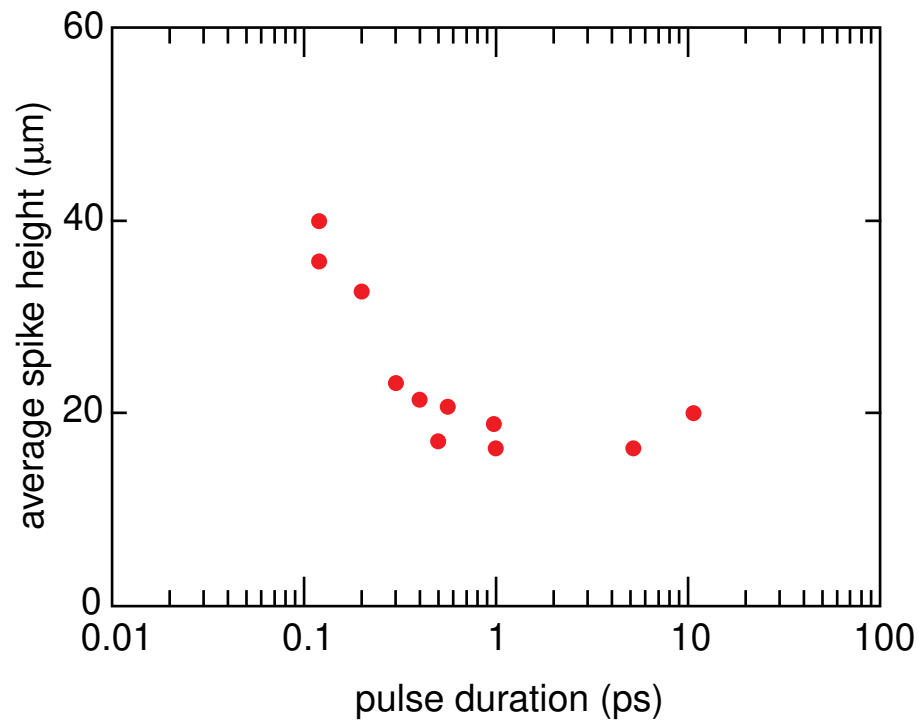


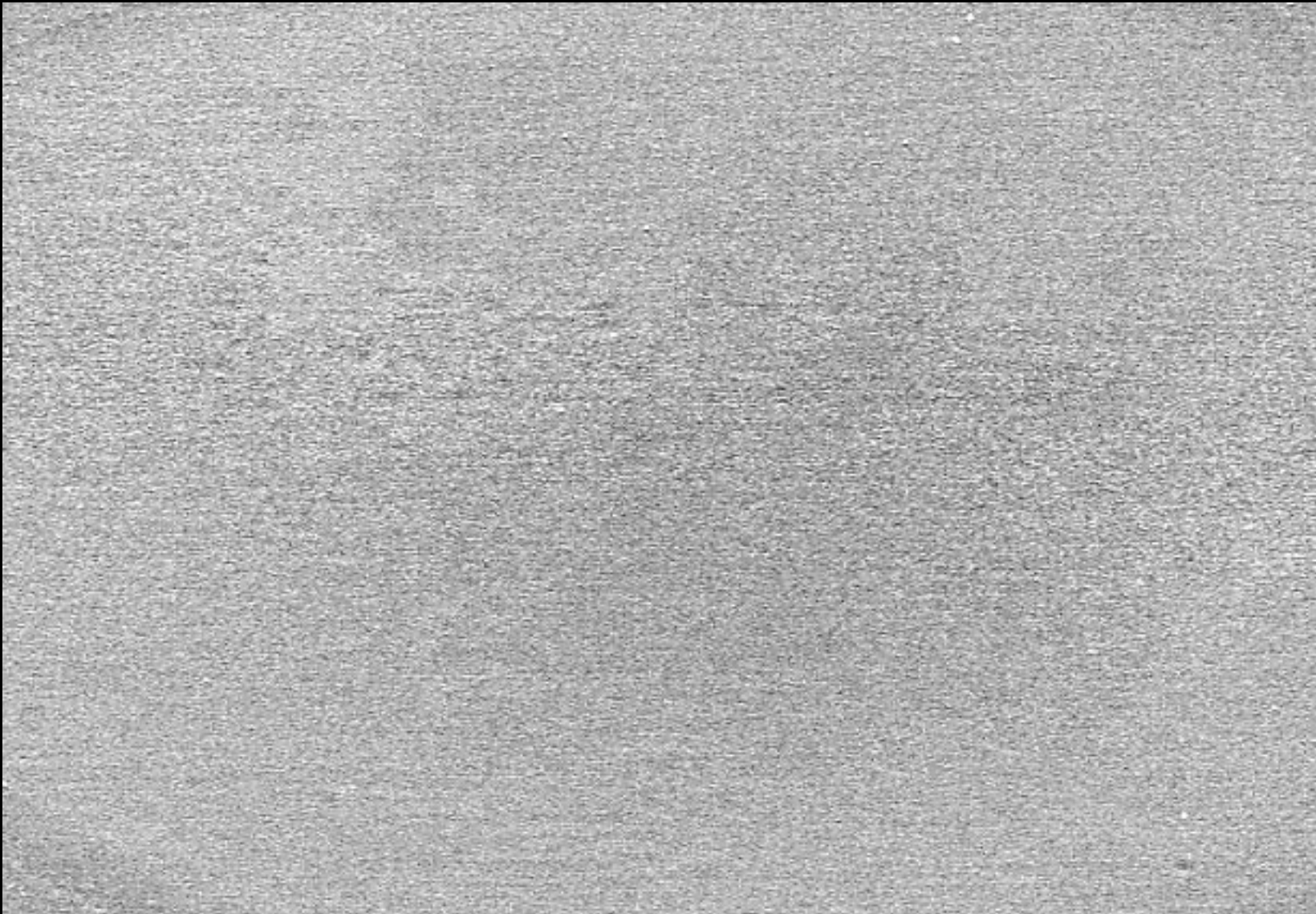
Conditions for formation



Conditions for formation

pulse duration dependence





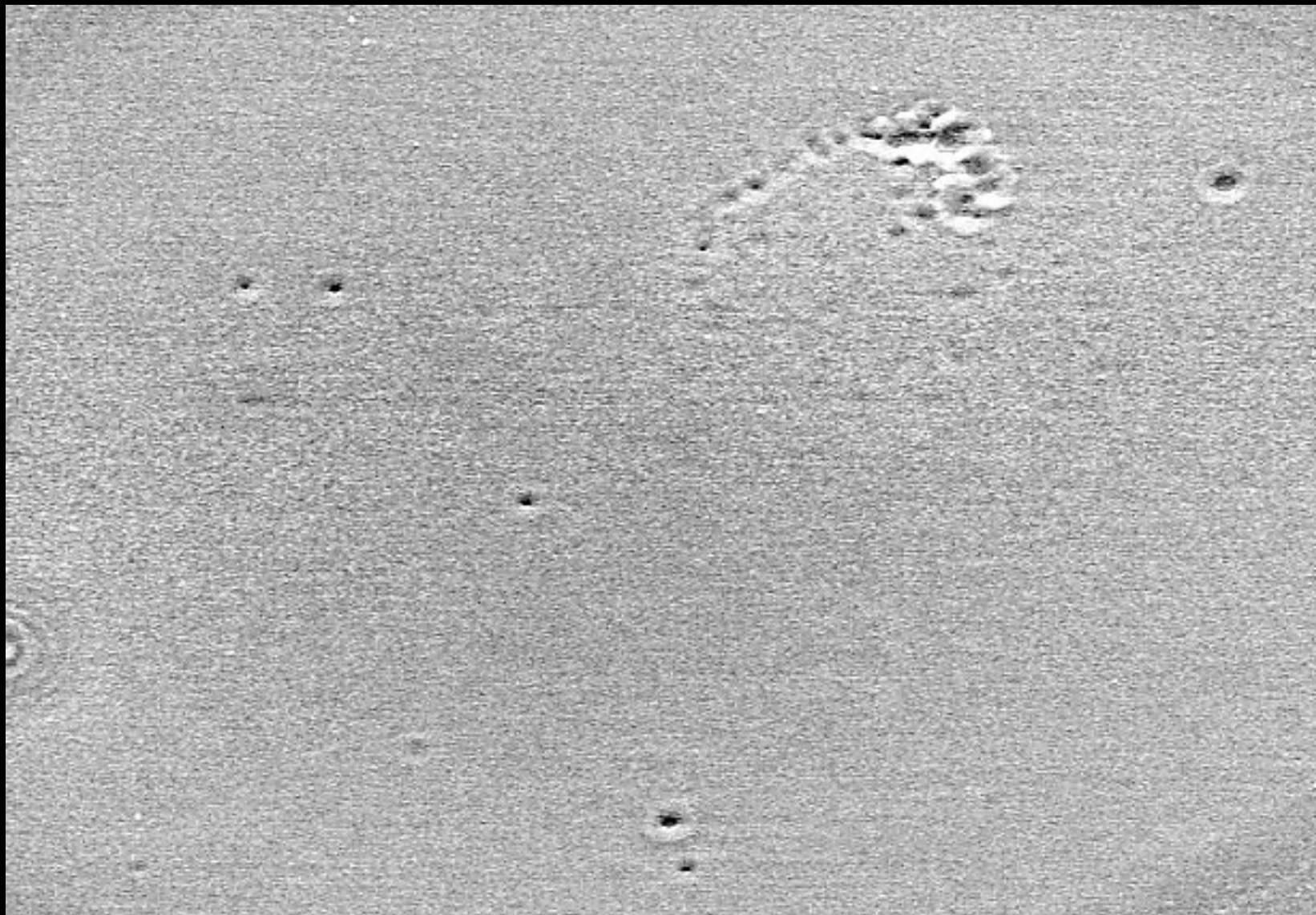
x2000
#3548
512 x 480

20 μ m

10kV

15mm

0000



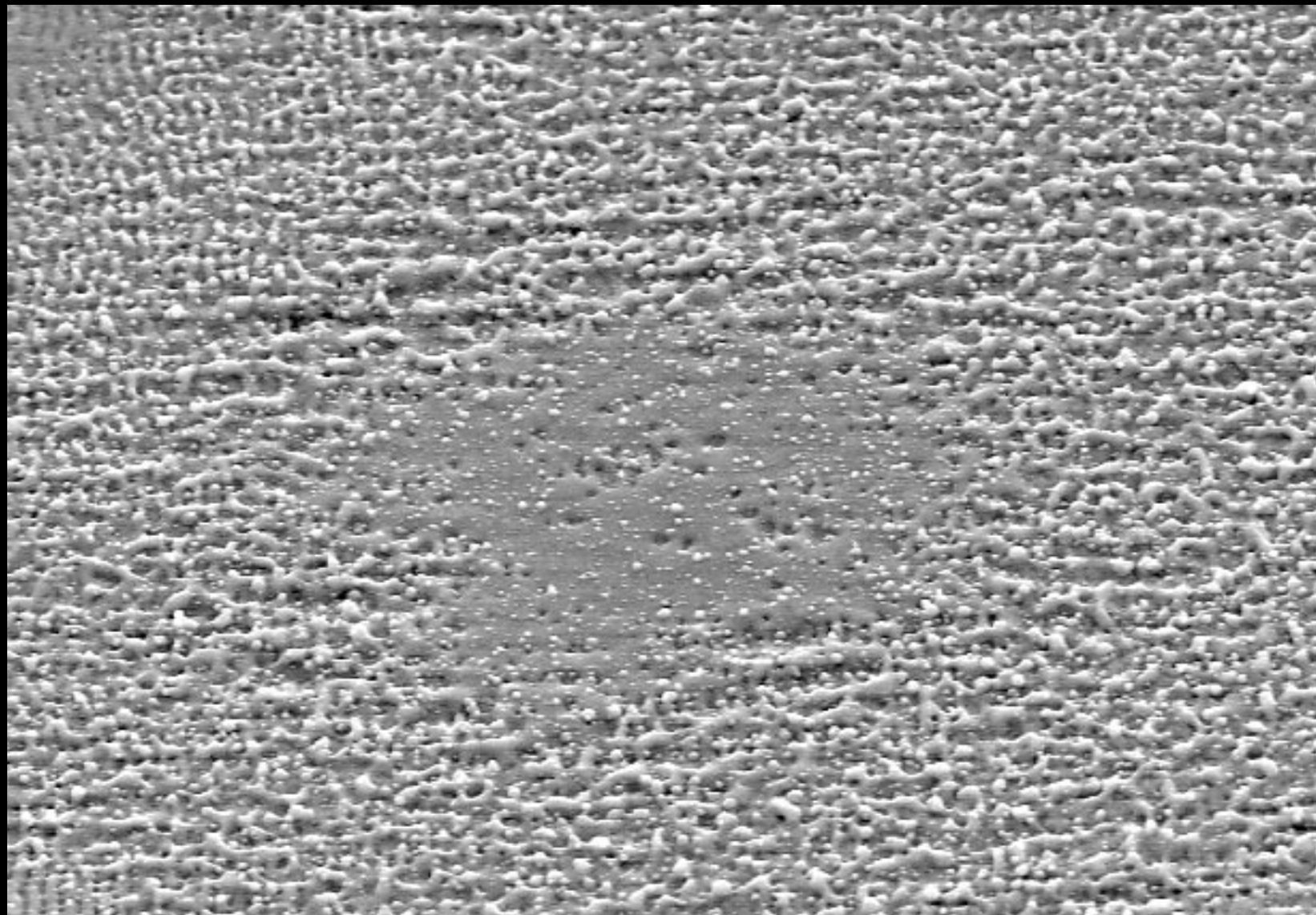
x2000
#3548
512 x 480

20 μm

10kV

15mm

0001



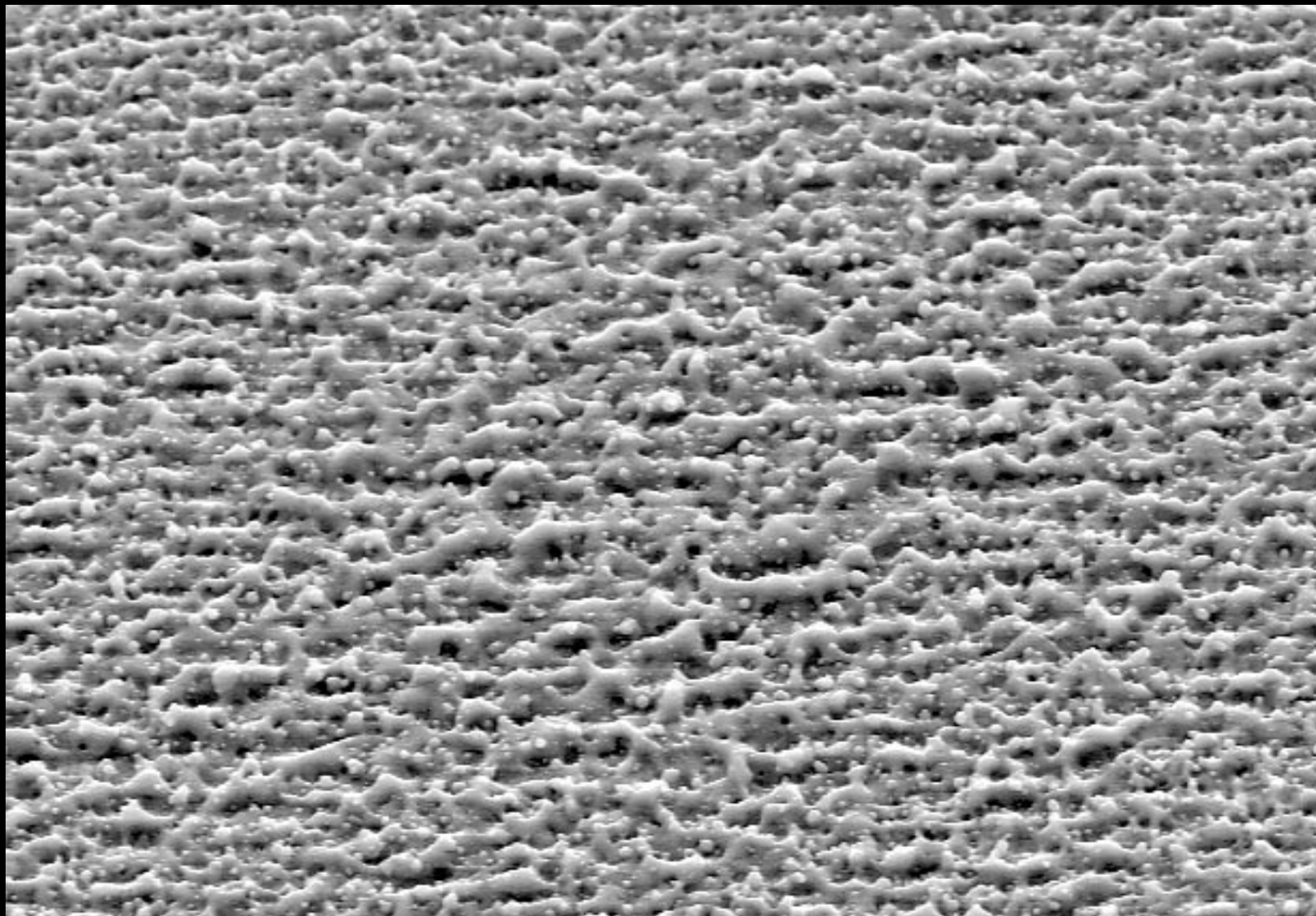
x2000
#3548
512 x 480

20 μm 

10kV

15mm

0005



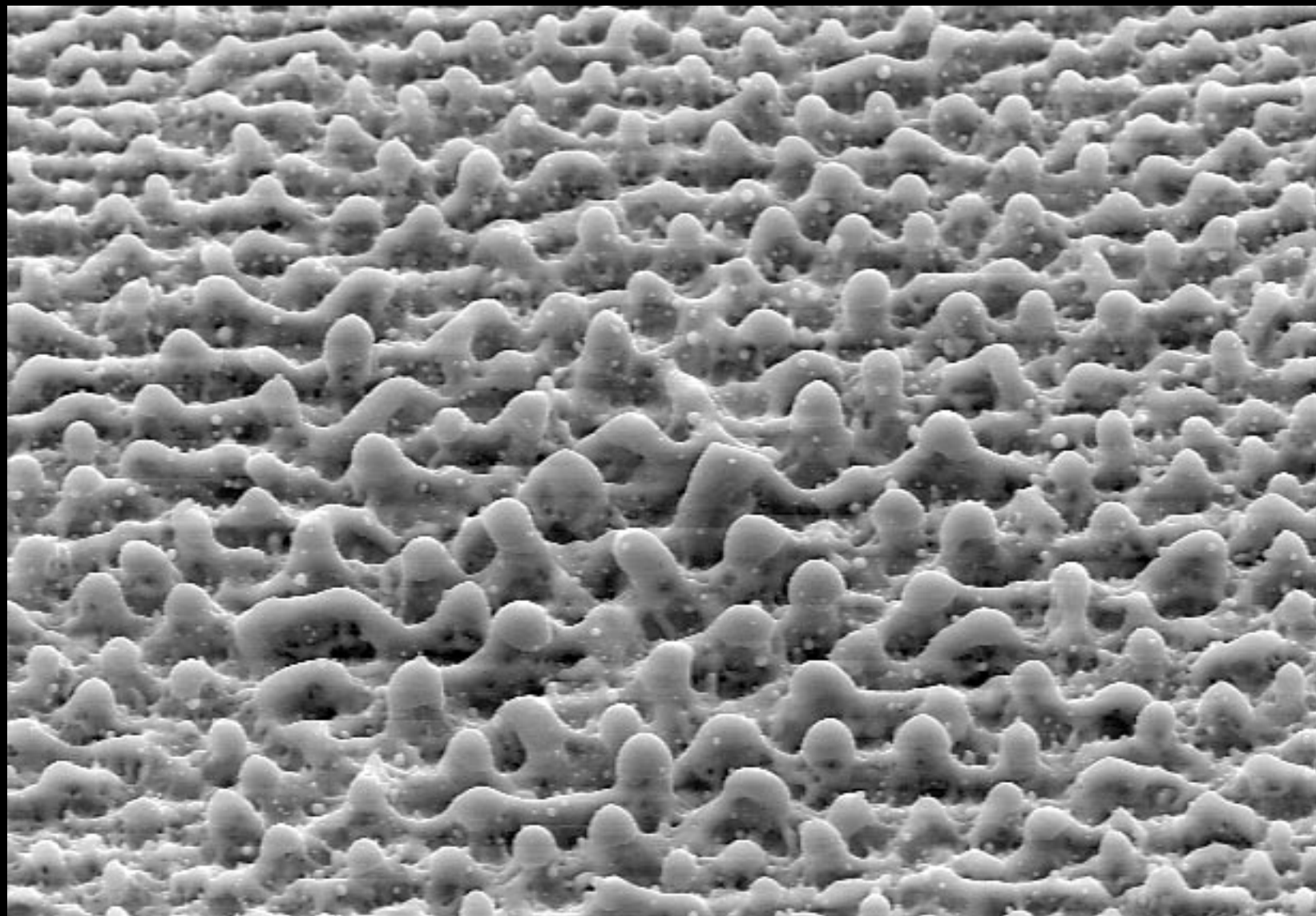
x2000
#3548
512 x 480

20 μm 

10kV

15mm

0010



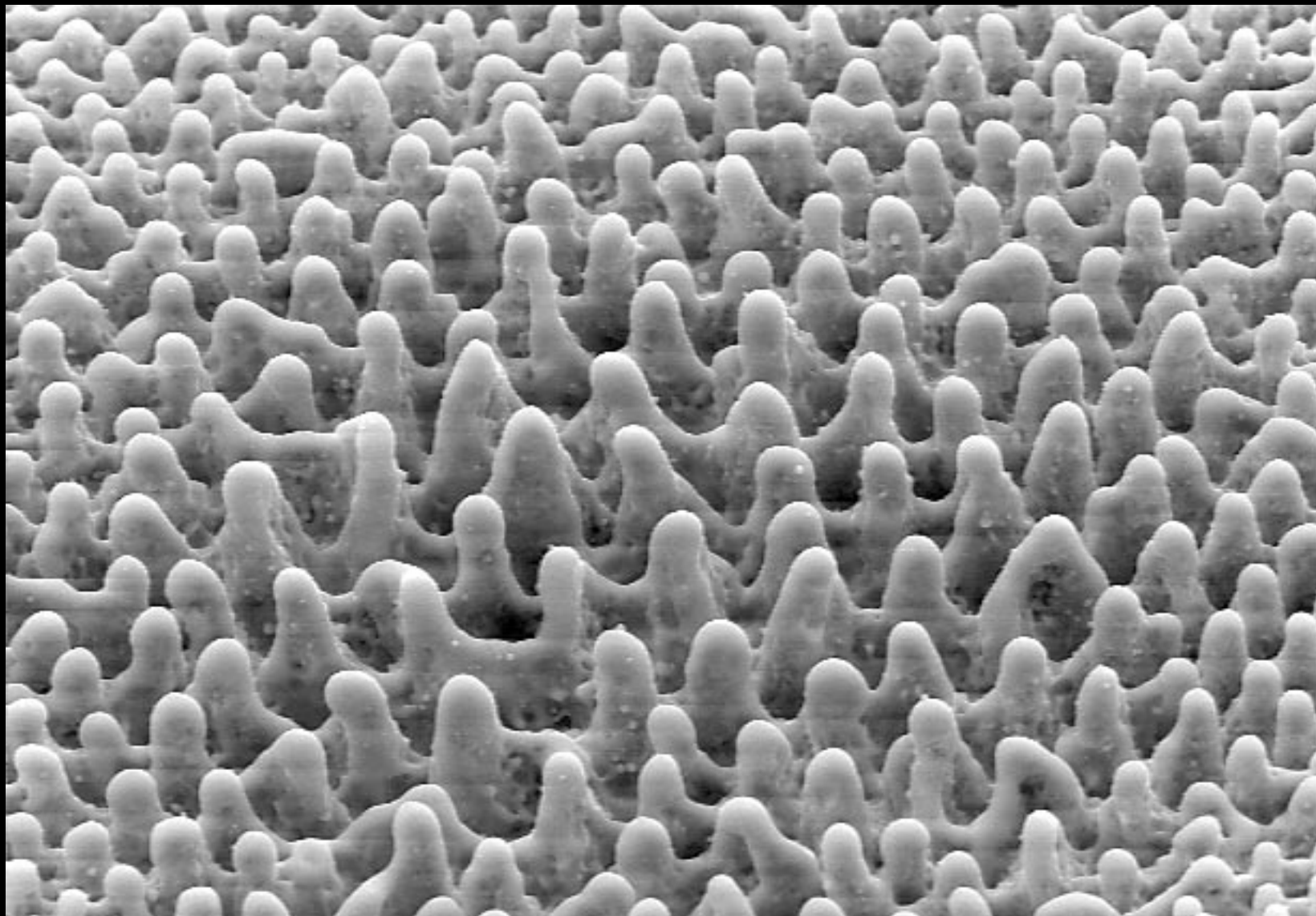
x2000
#3548
512 x 480

20 μ m

10kV

15mm

0025



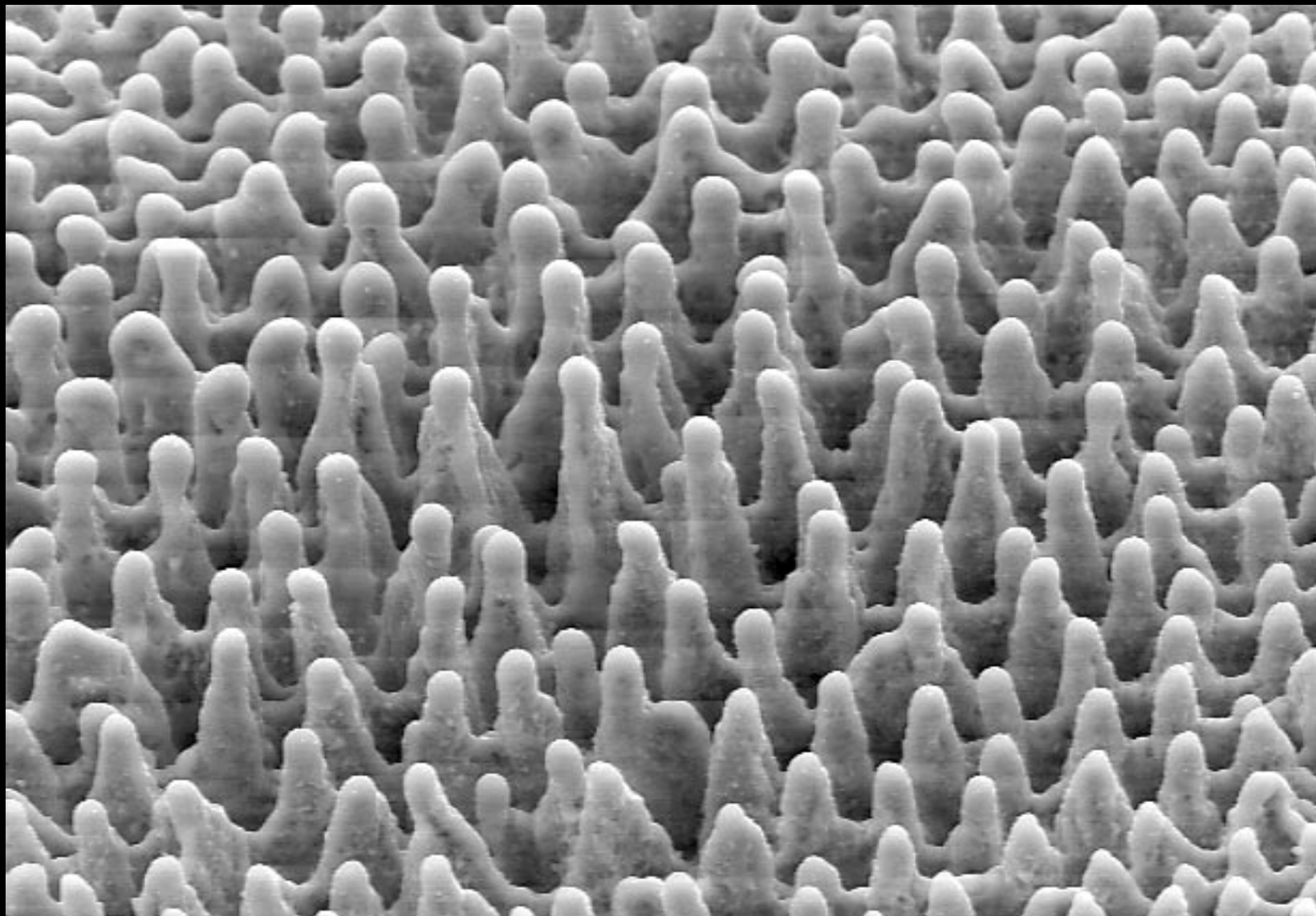
x2000
#3548
512 x 480

20 μ m

10kV

15mm

0050



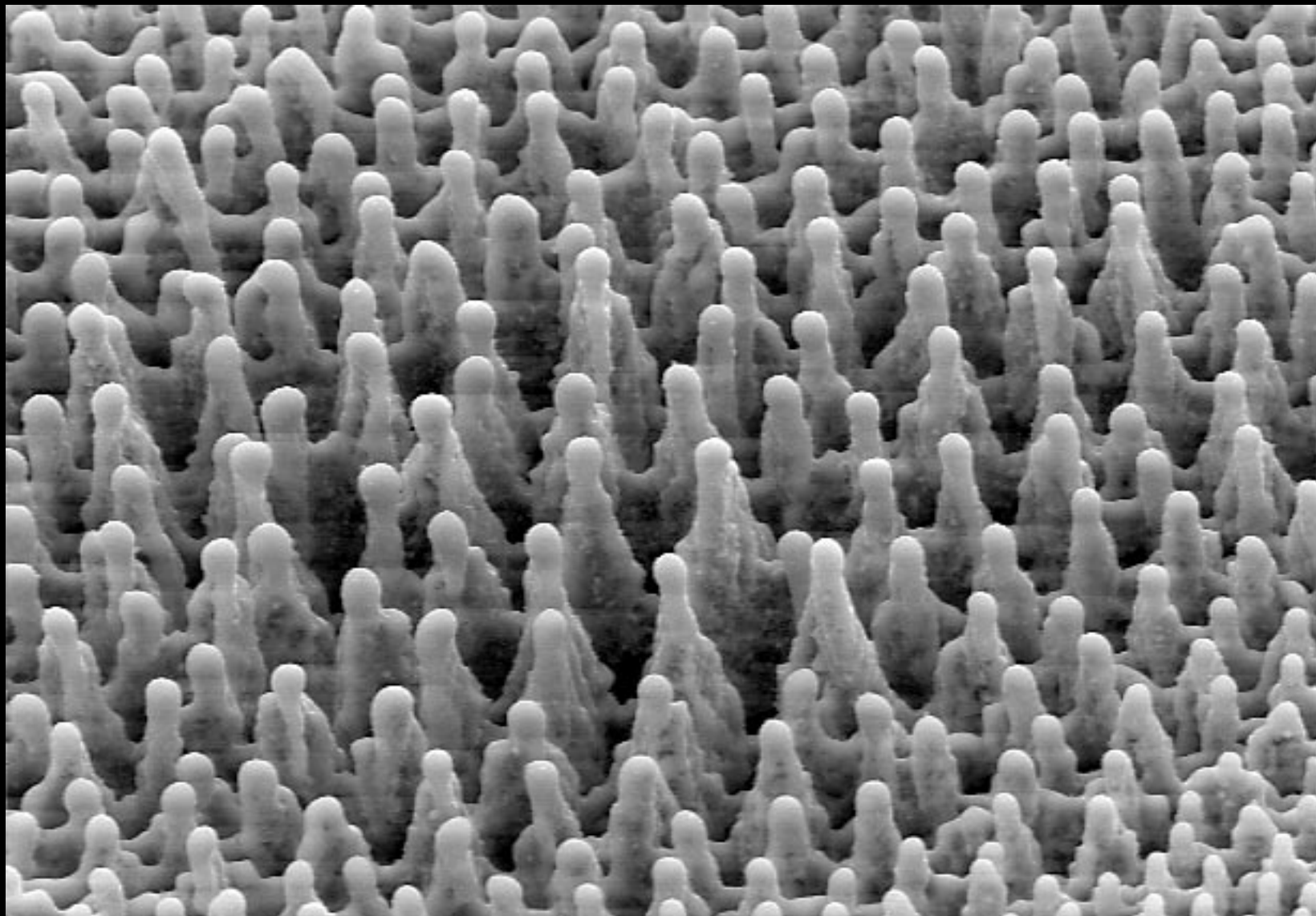
x2000
#3548
512 x 480

20 μ m

10kV

15mm

0075



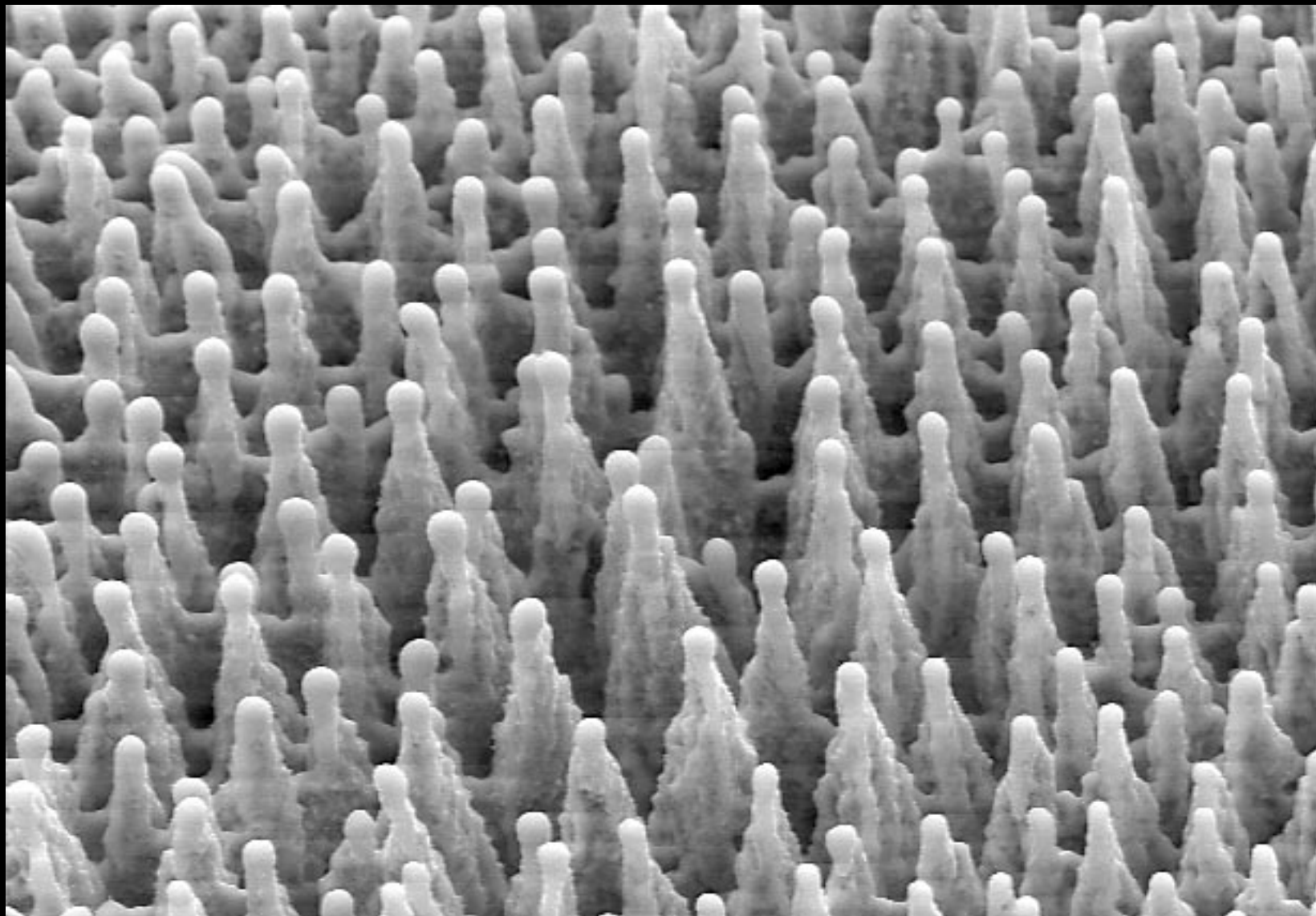
x2000
#3548
512 x 480

20 μ m

10kV

15mm

0125



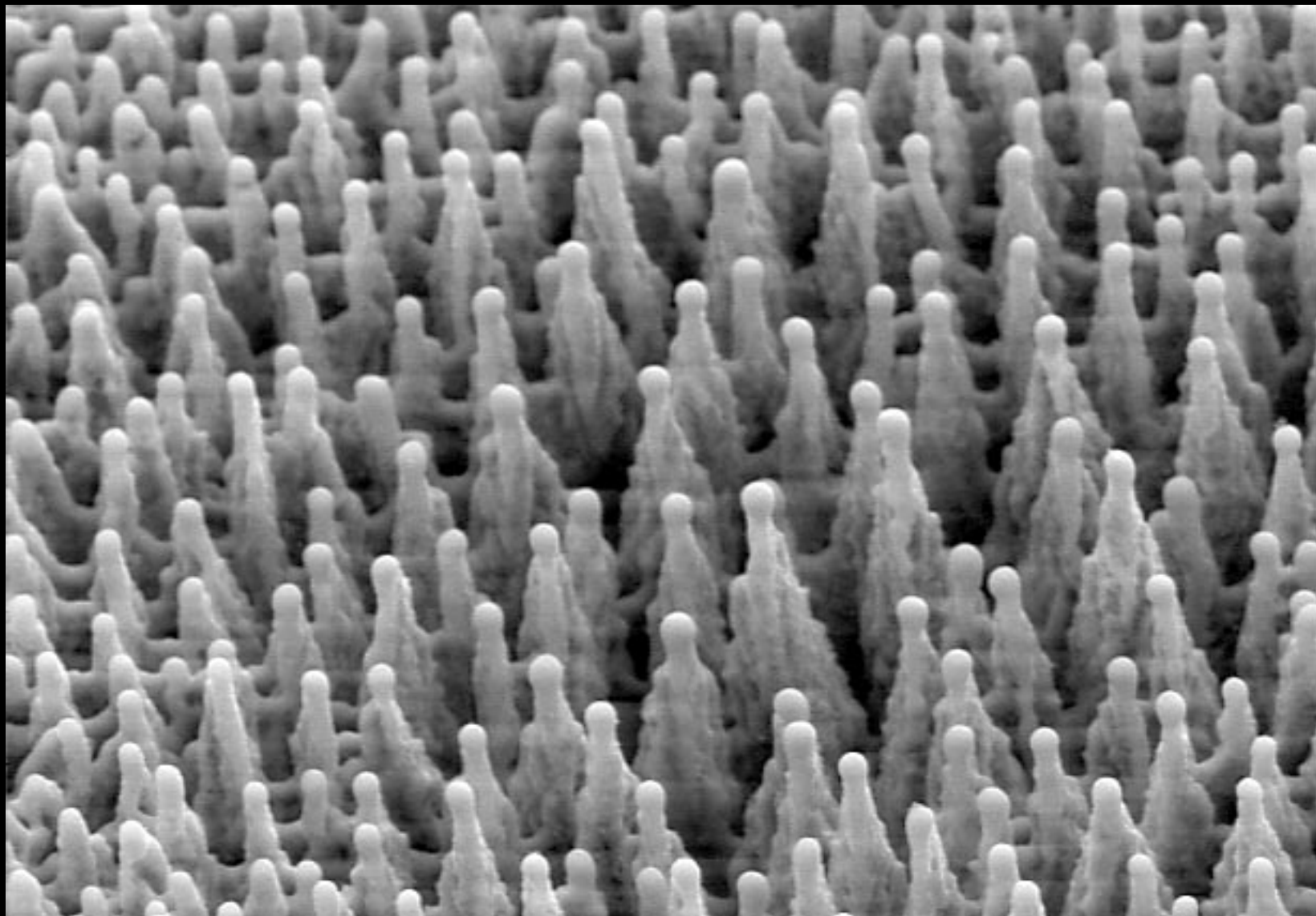
x2000
#3548
512 x 480

20 μ m

10kV

15mm

0250



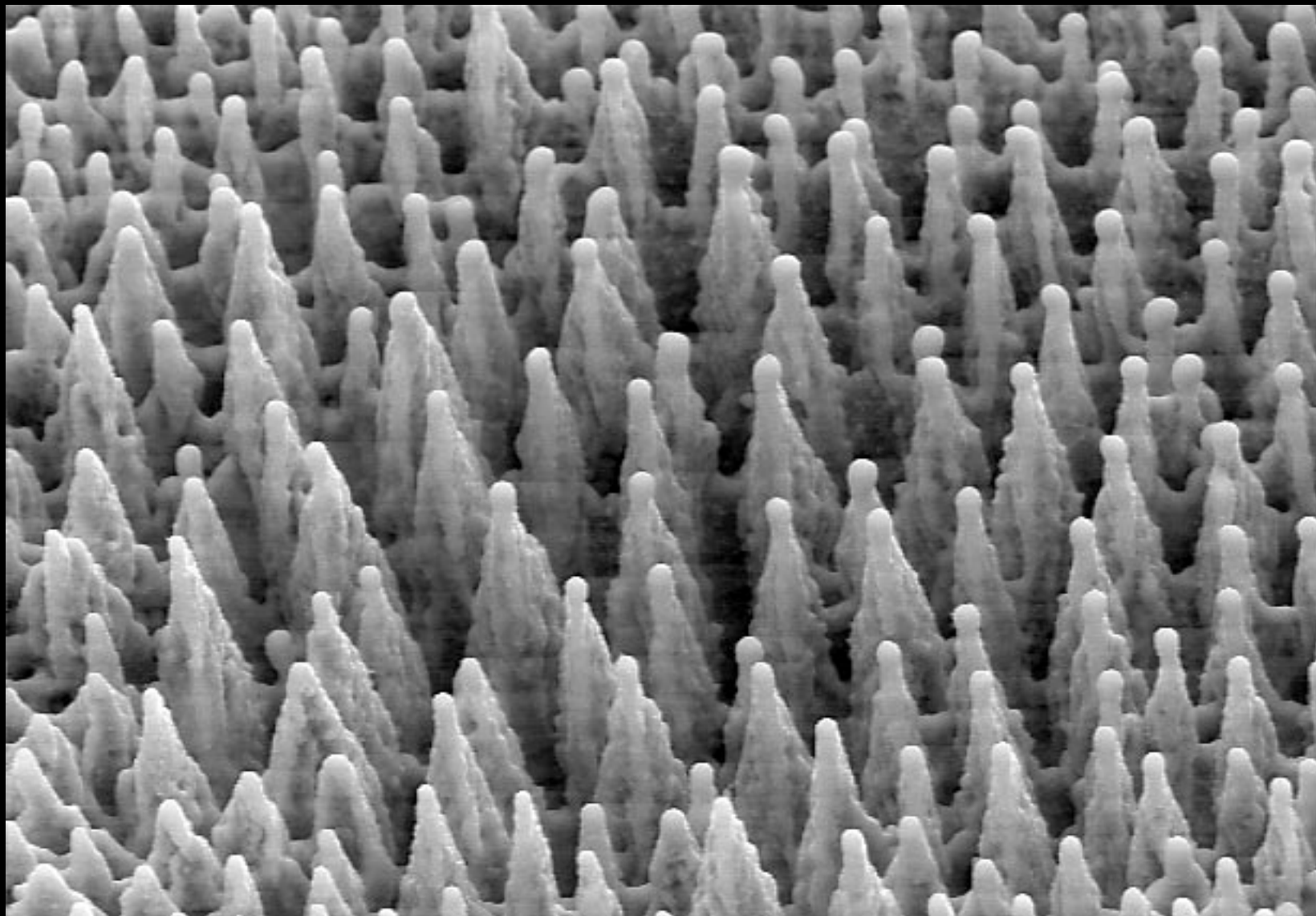
x2000
#3548
512 x 480

20 μ m

10kV

15mm

0350



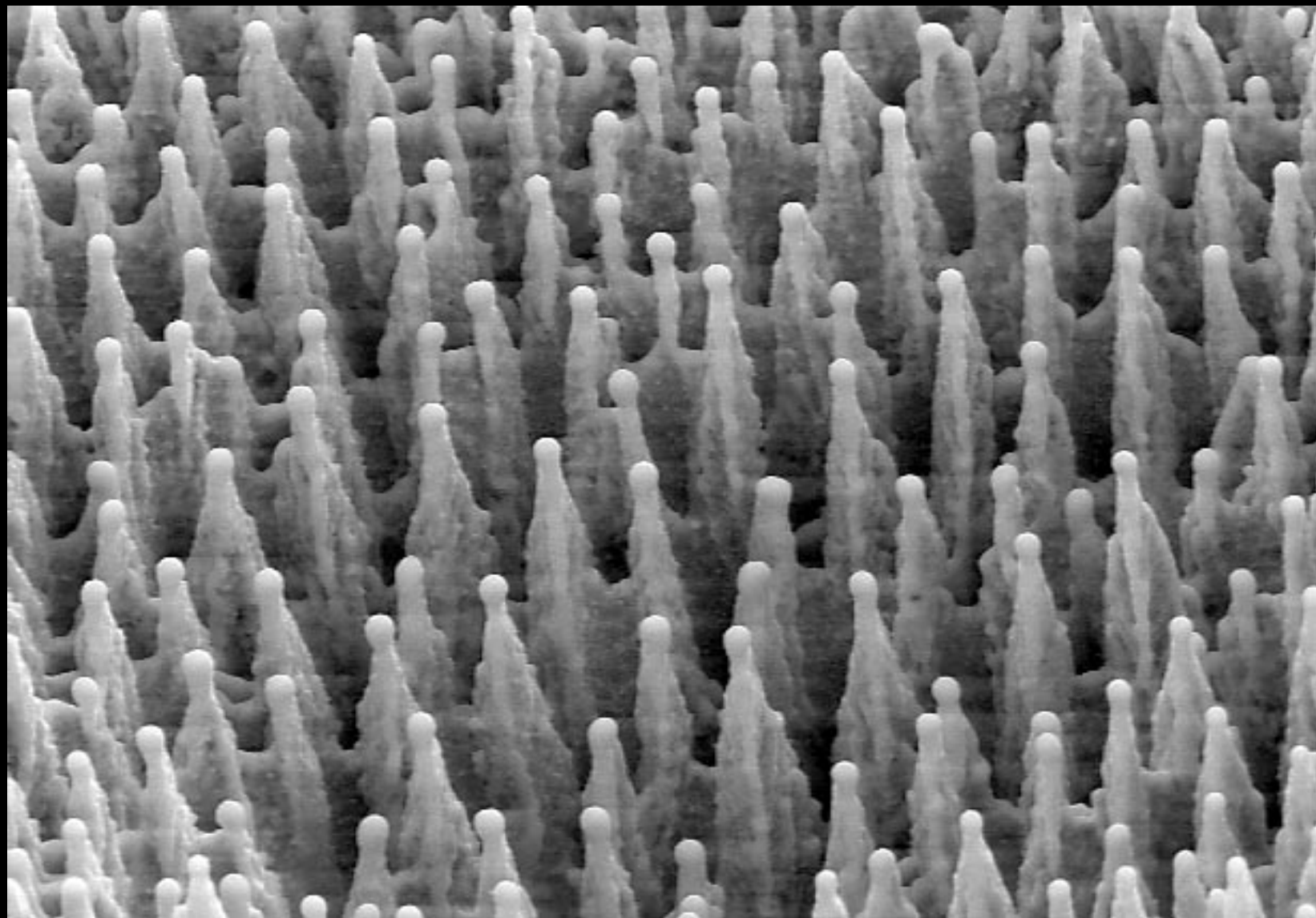
x2000
#3548
512 x 480

20 μ m

10kV

15mm

0450



x2000
#3548
512 x 480

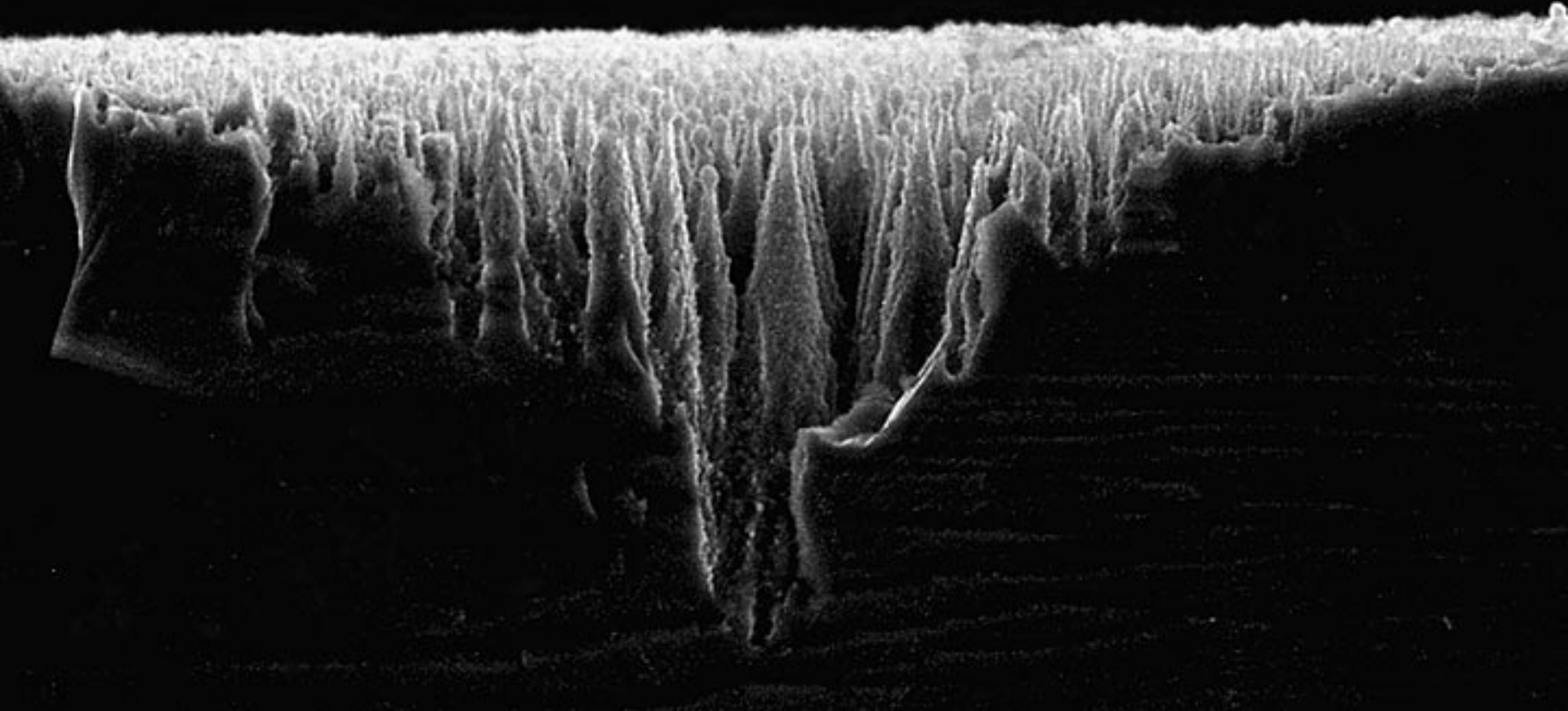
20 μ m

10kV

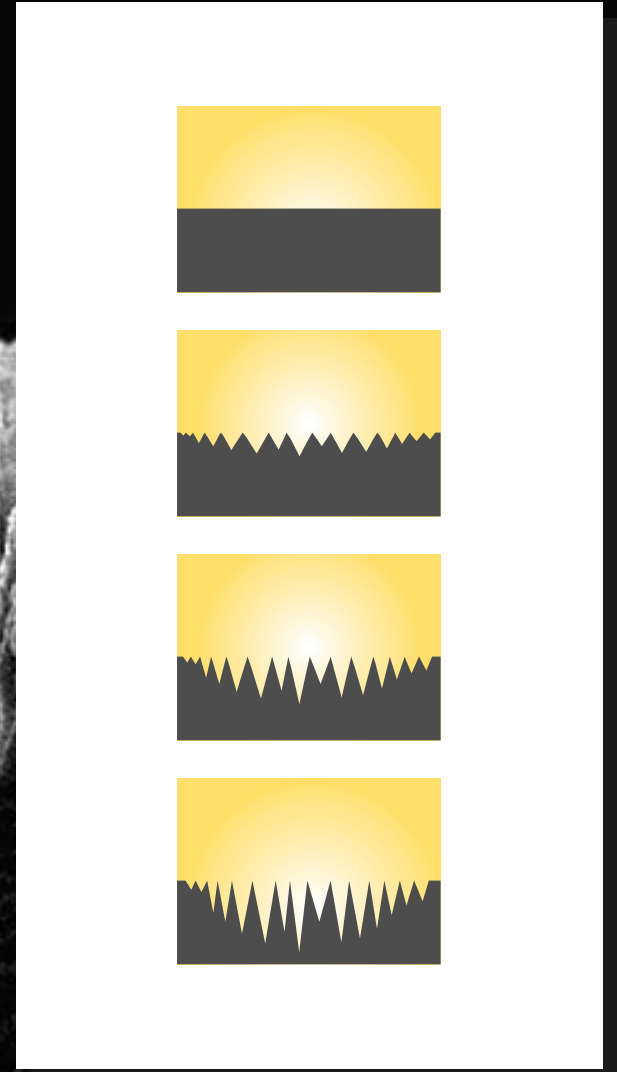
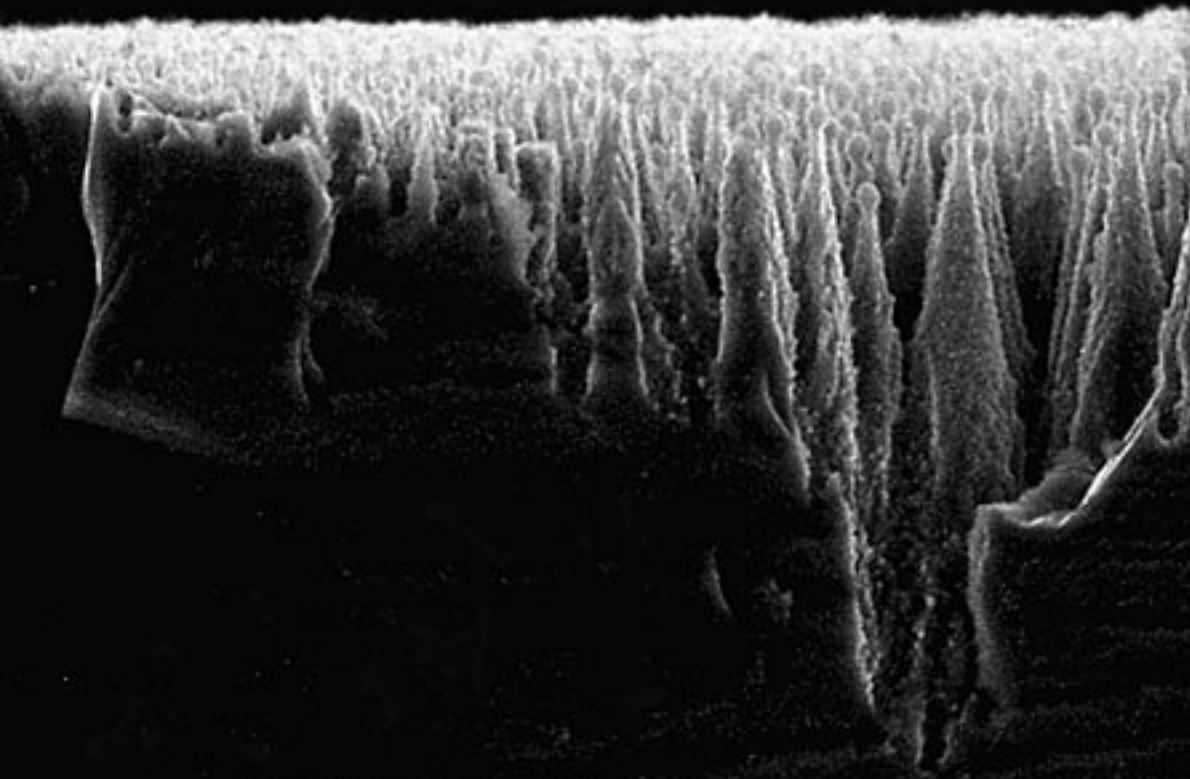
15mm

1000

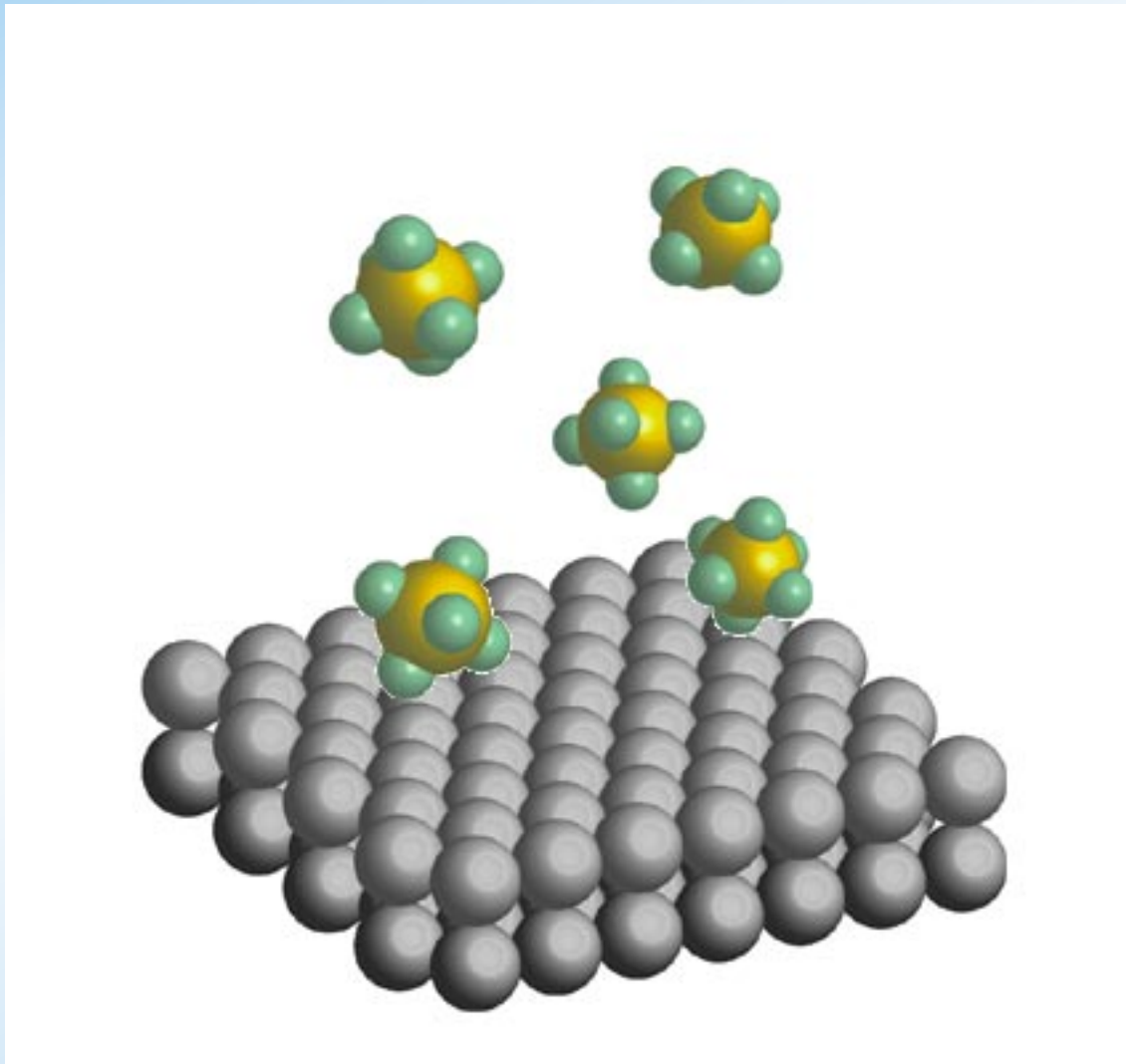
Mechanism



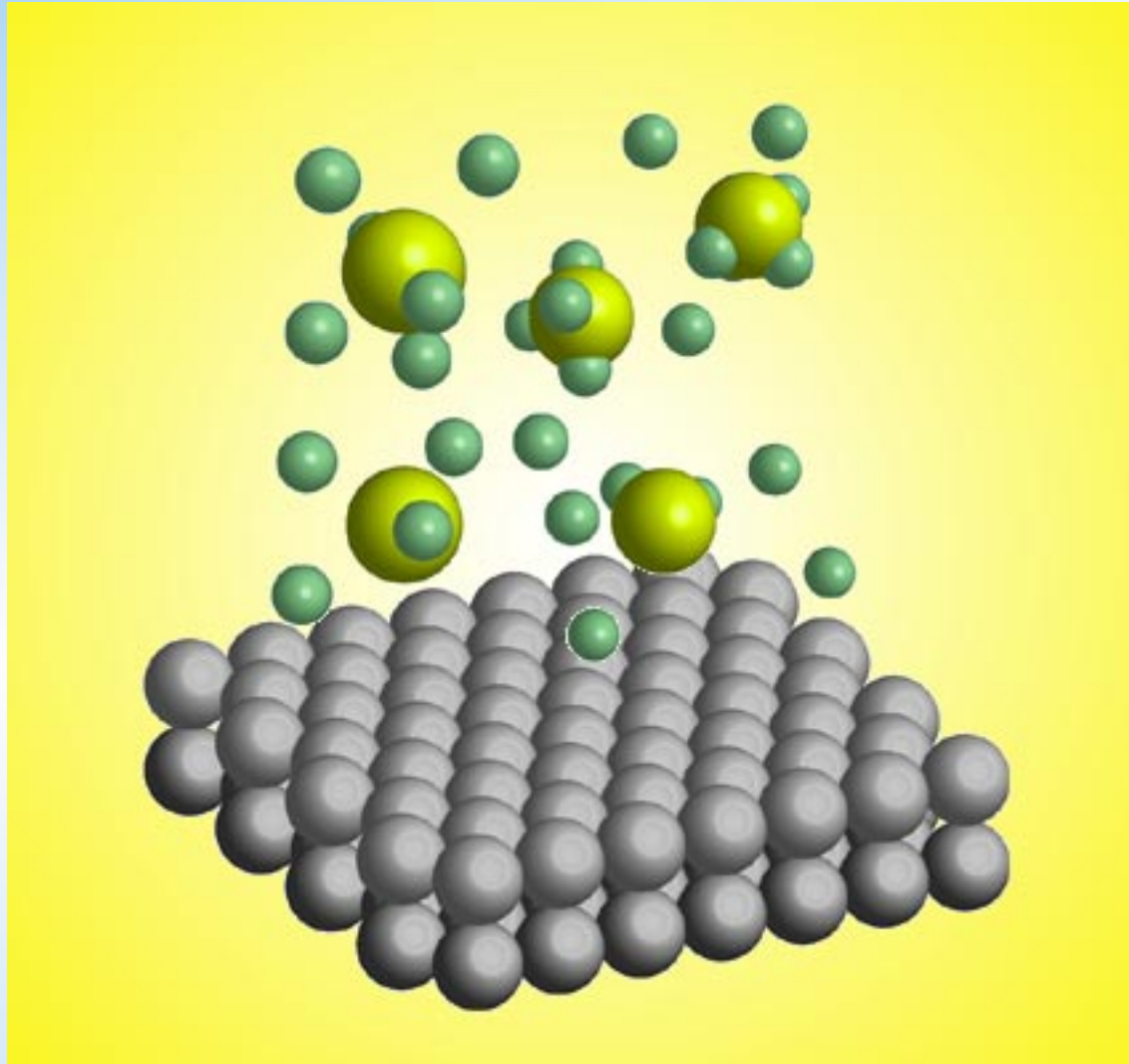
Mechanism



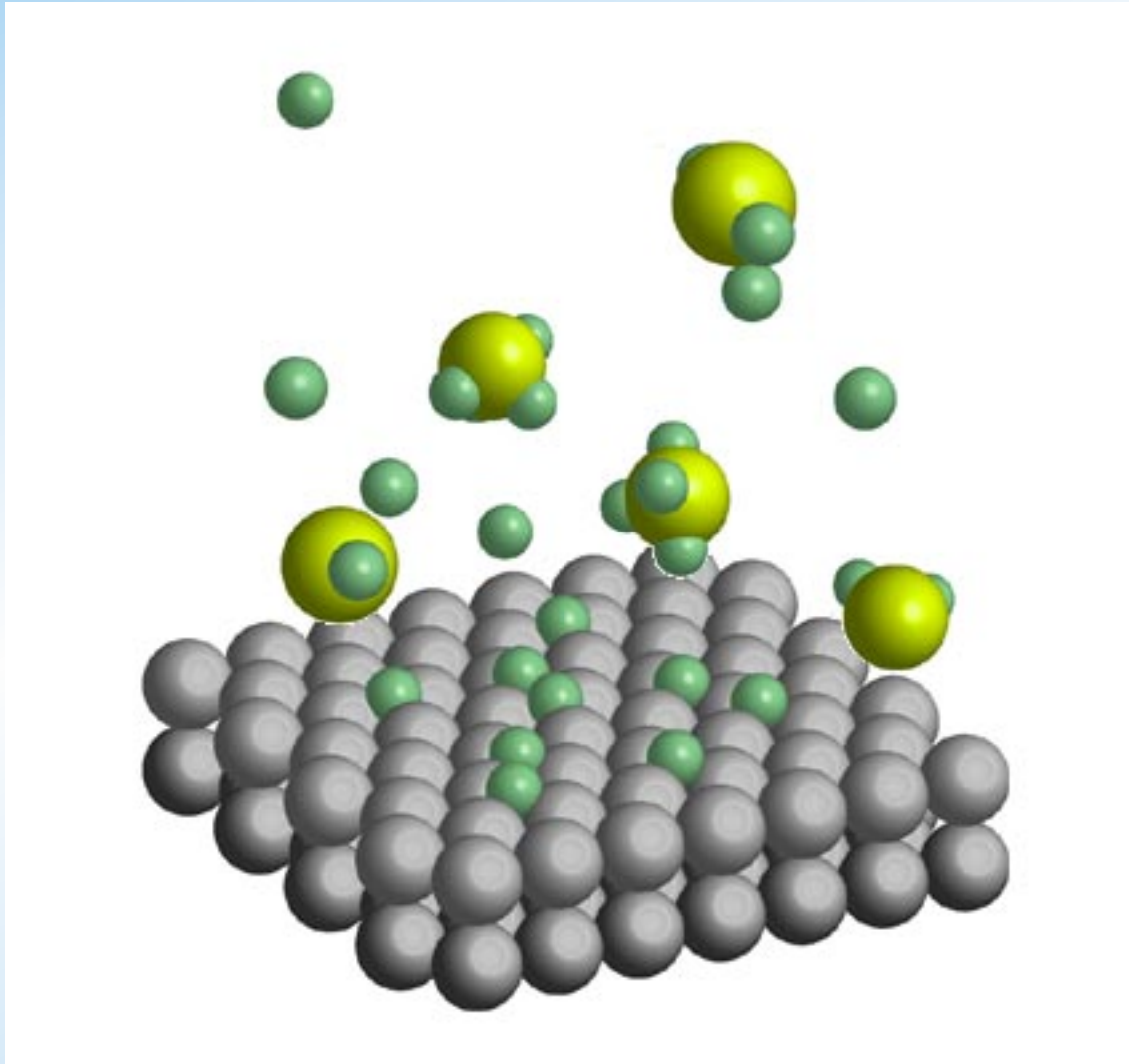
Mechanism



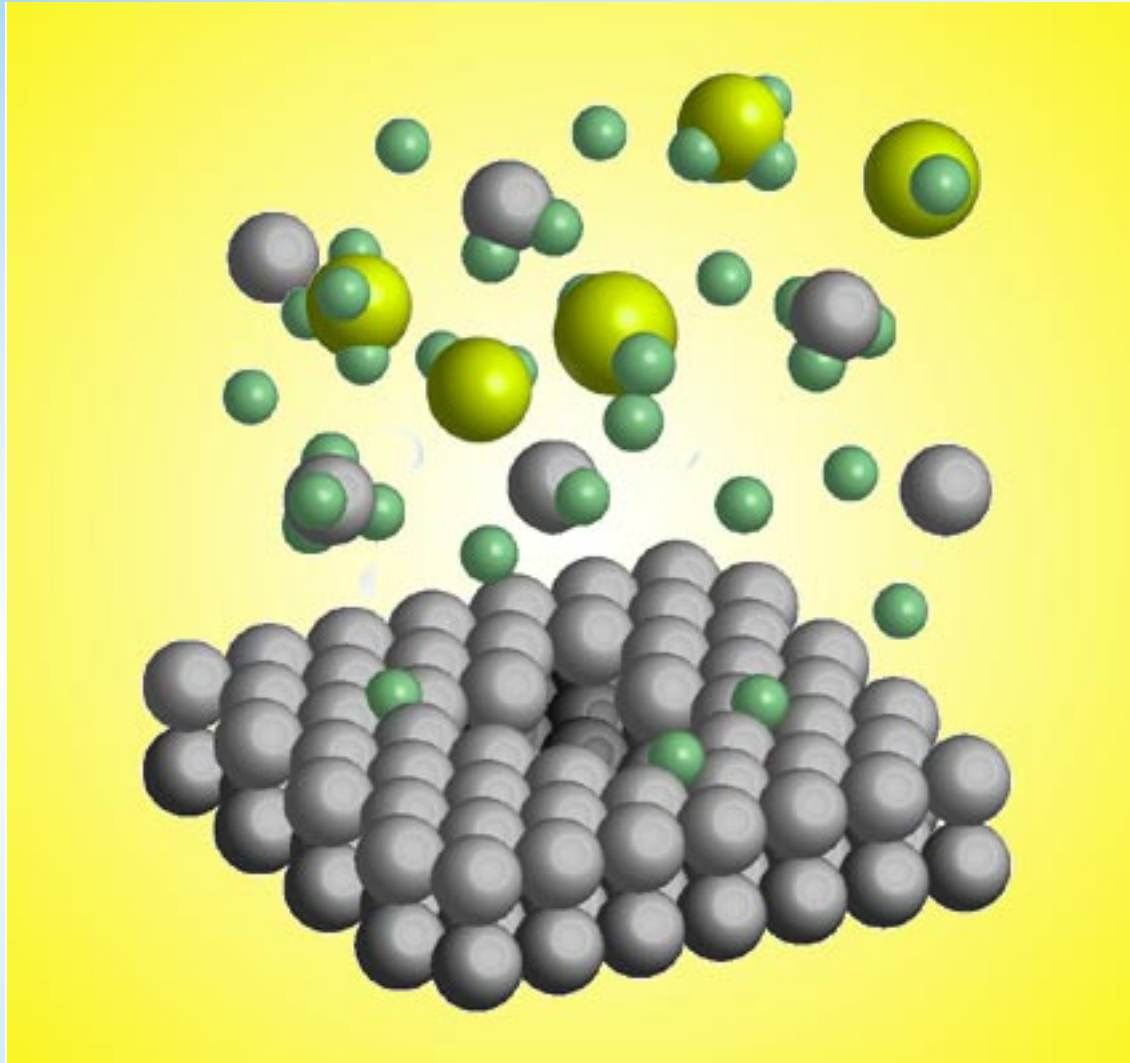
Mechanism



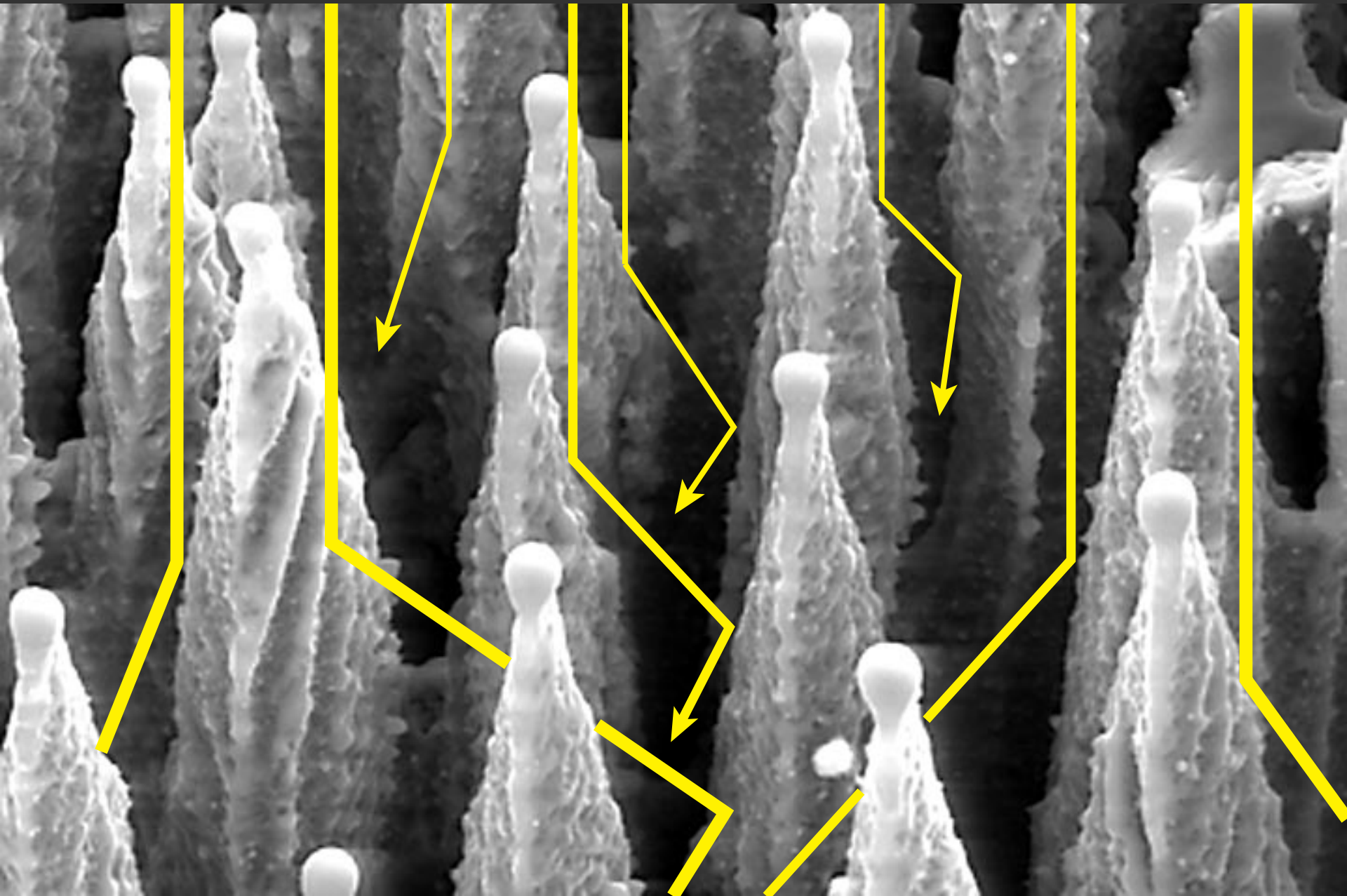
Mechanism



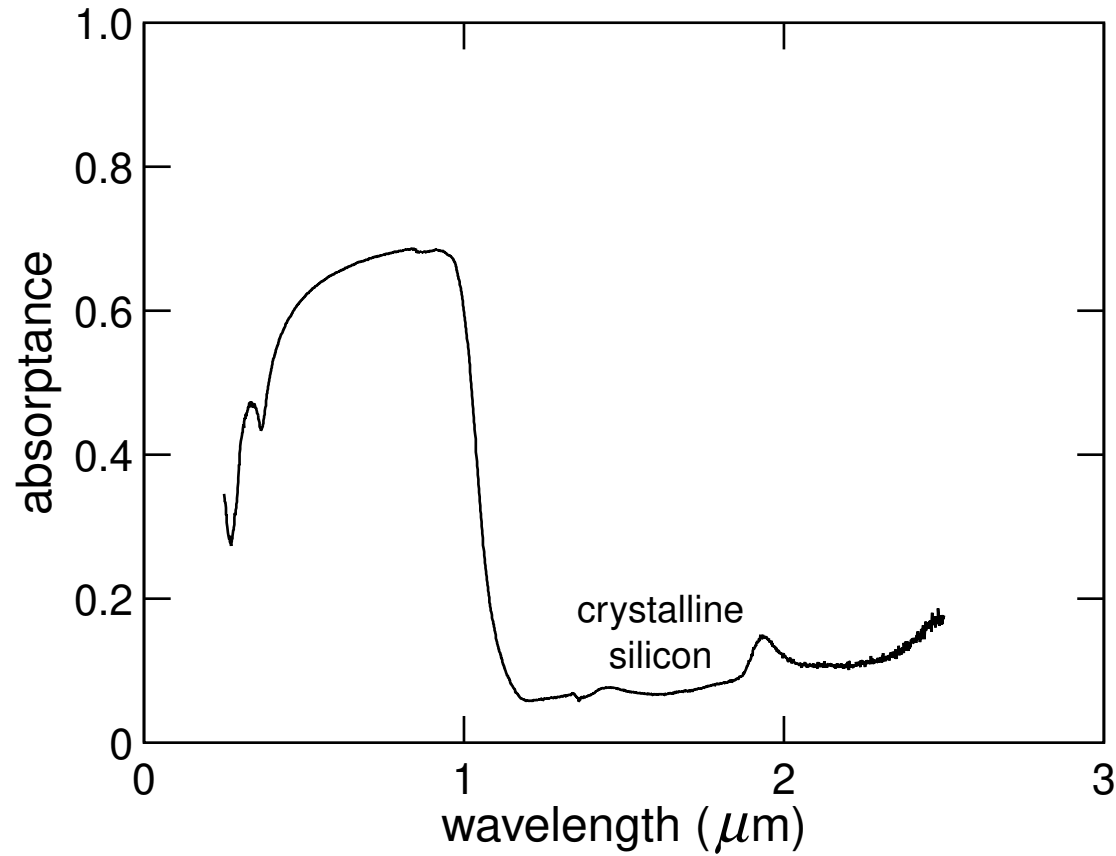
Mechanism



Light absorption

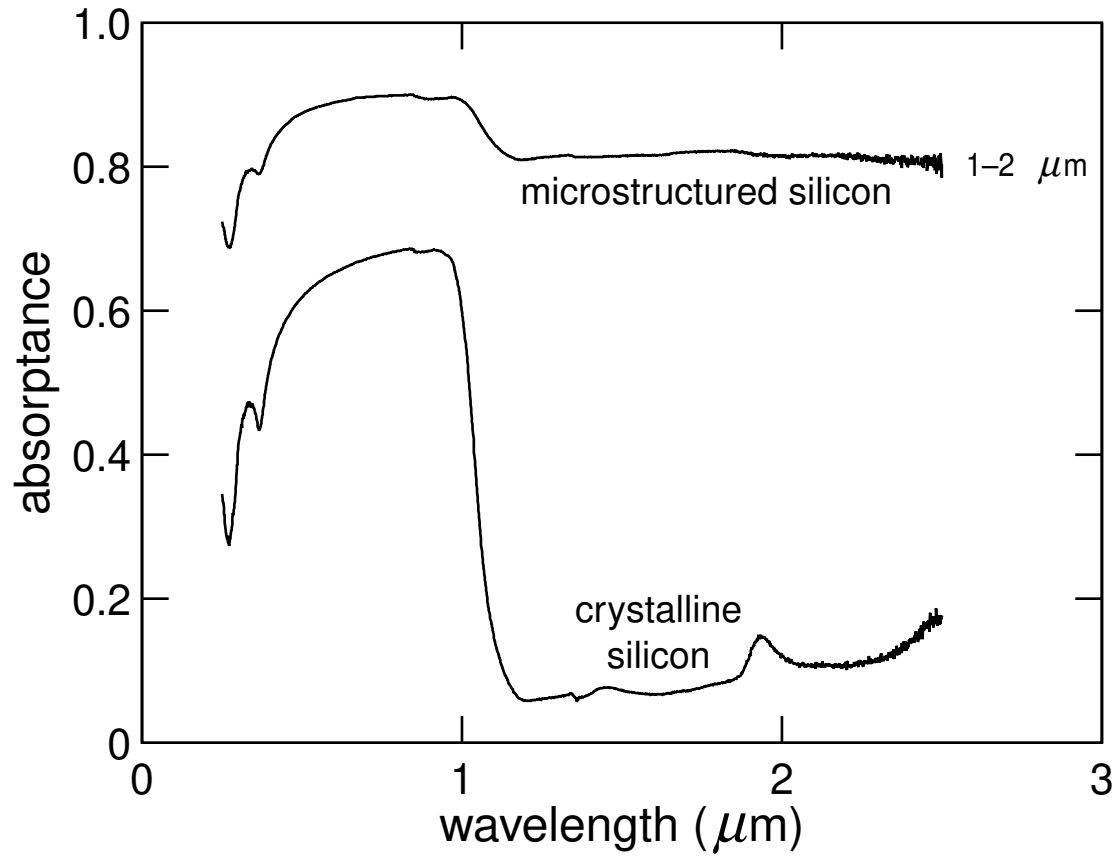


Light absorption



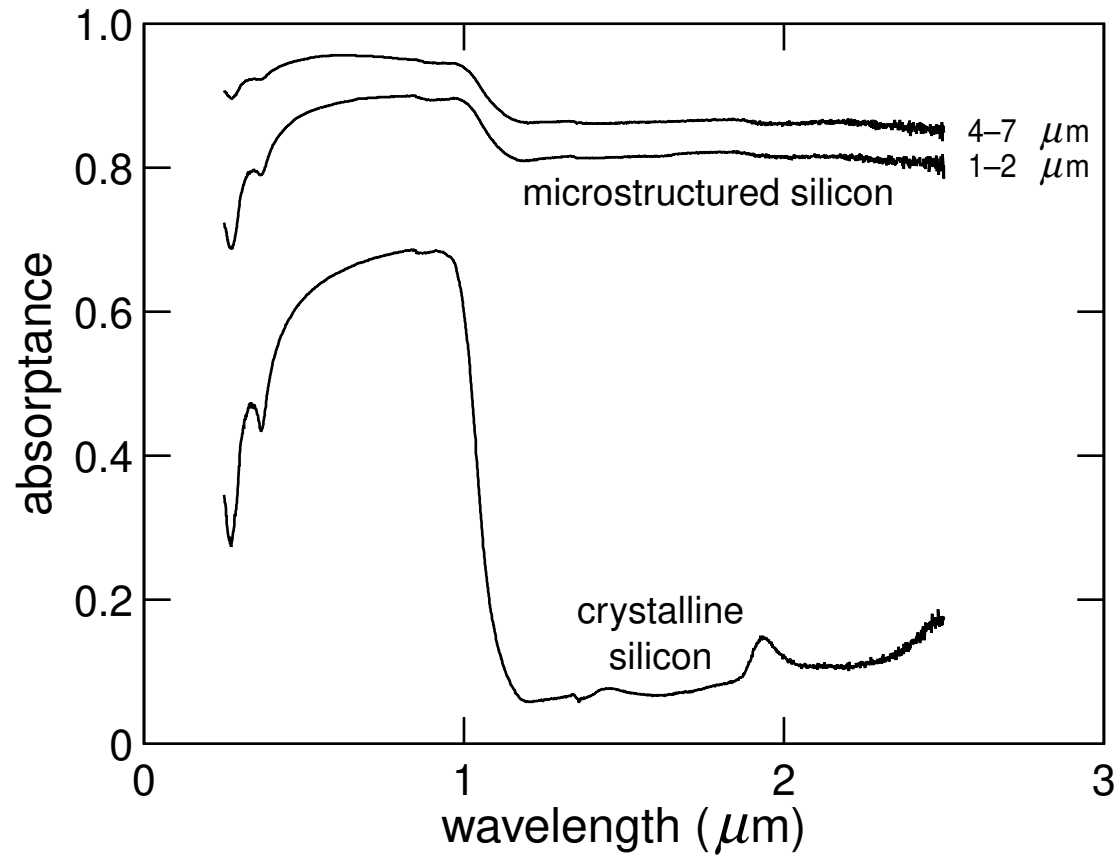
C. Wu, et al., *Appl. Phys. Lett.* 78, 1850 (2001)

Light absorption

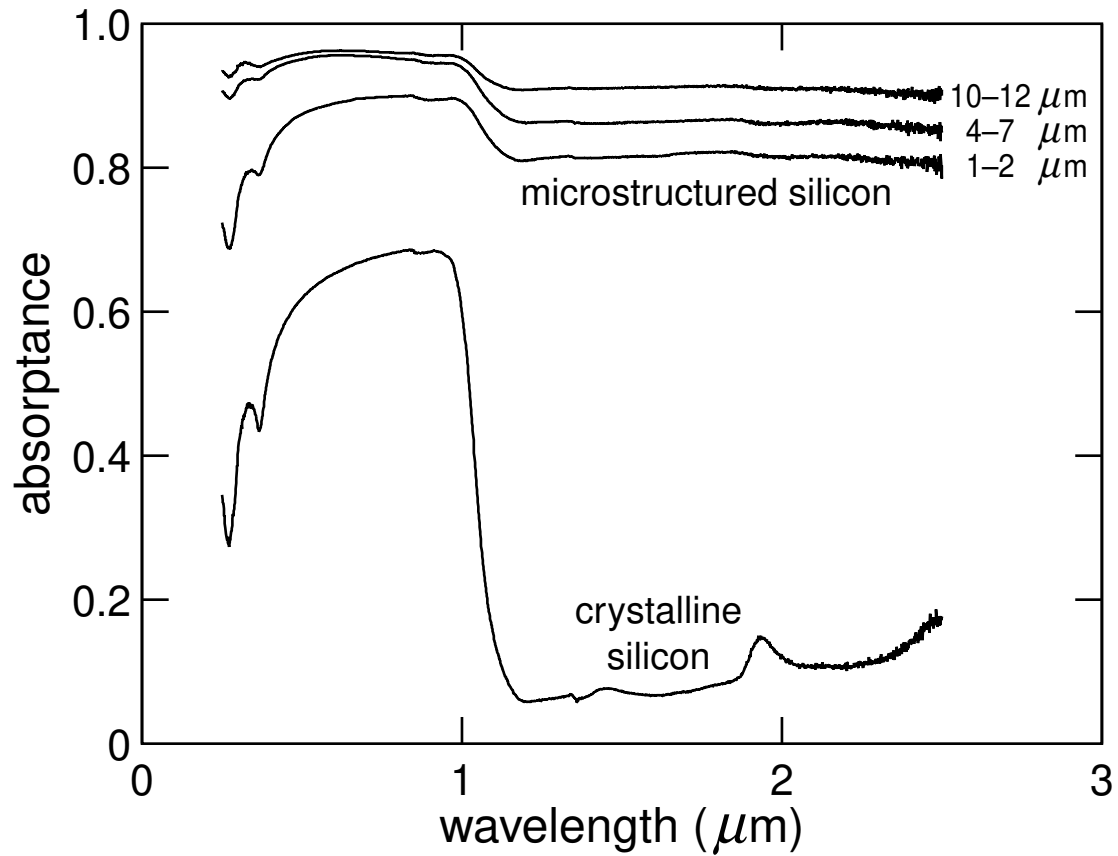


C. Wu, et al., *Appl. Phys. Lett.* 78, 1850 (2001)

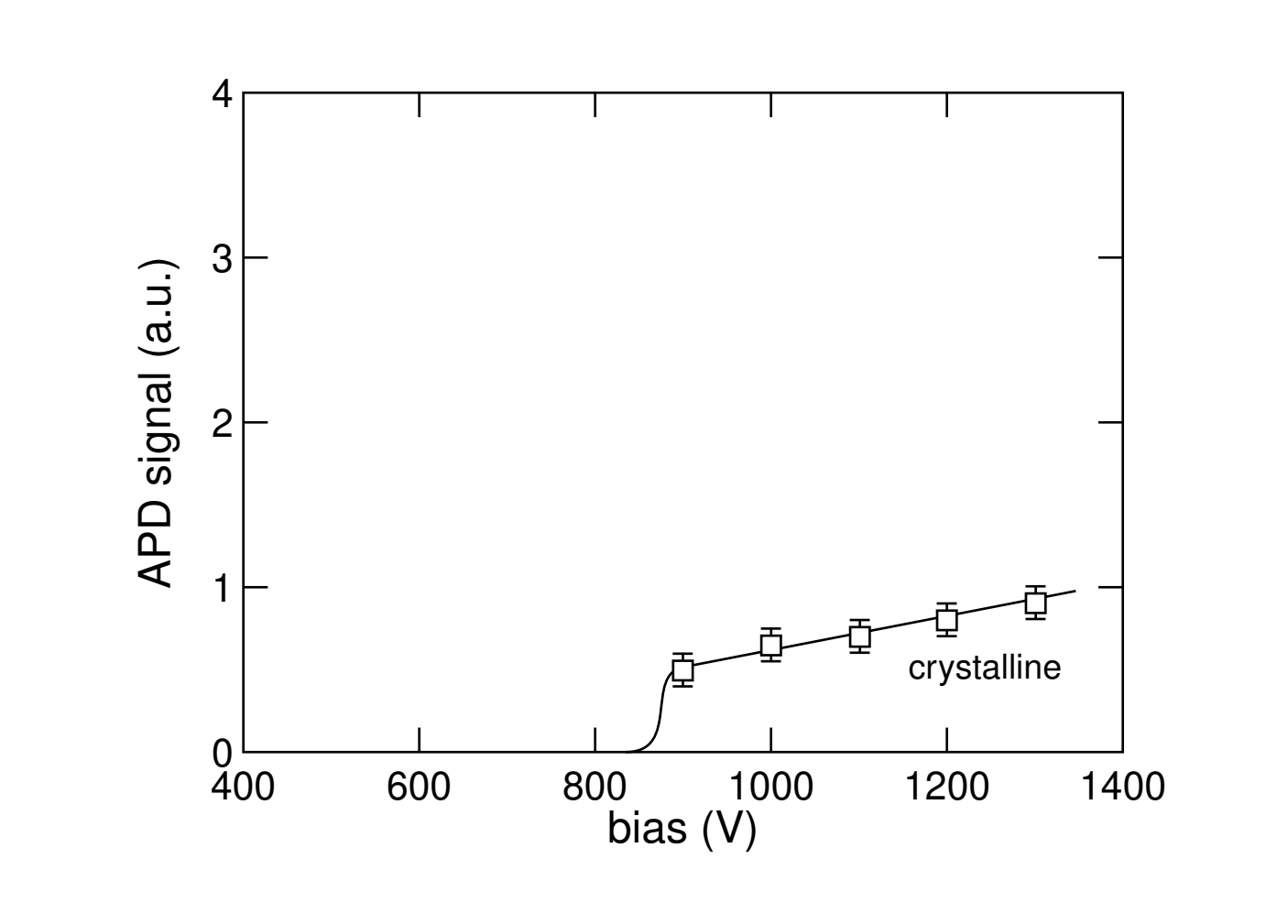
Light absorption



Light absorption

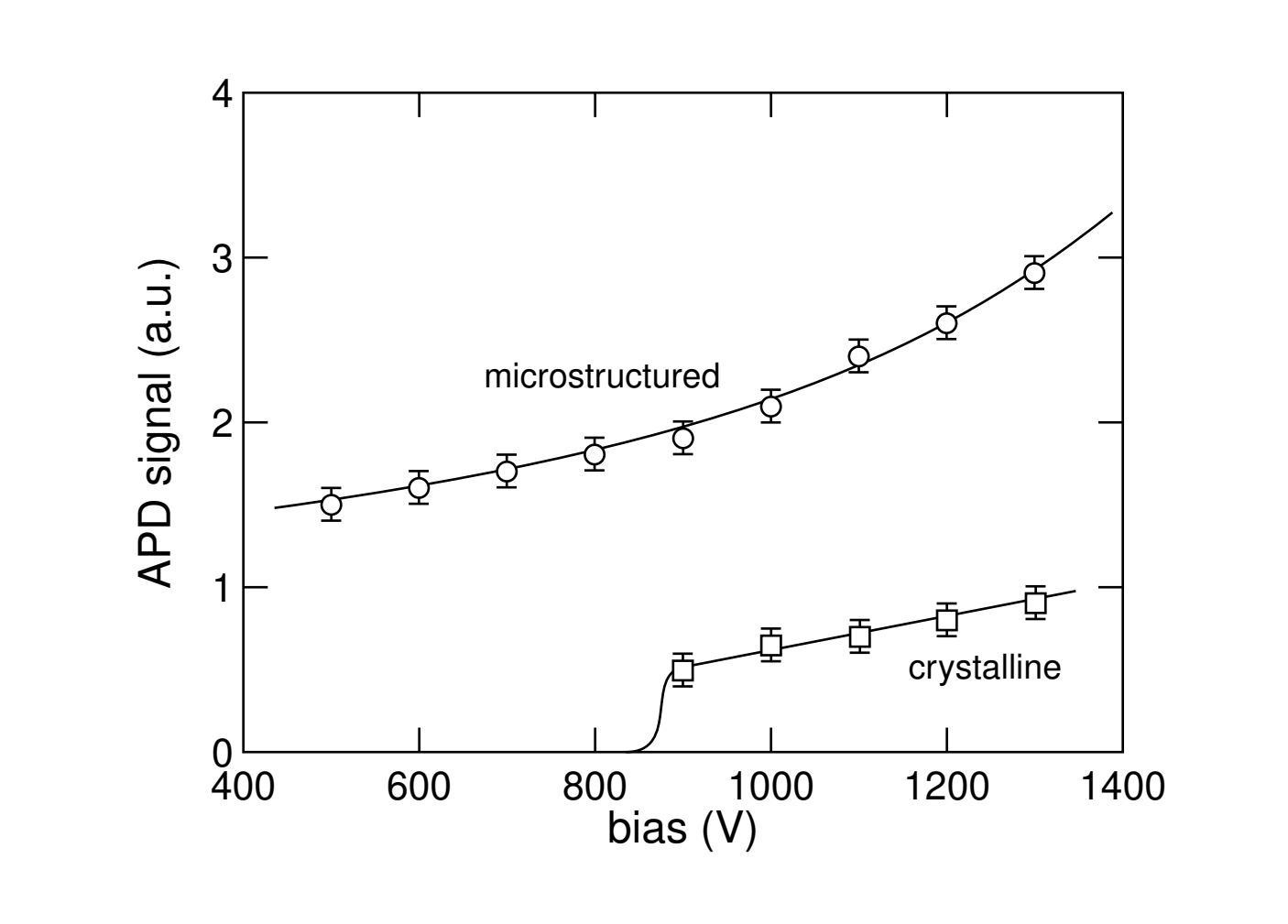


IR photocurrent



in collaboration with RMD

IR photocurrent



in collaboration with RMD

Summary

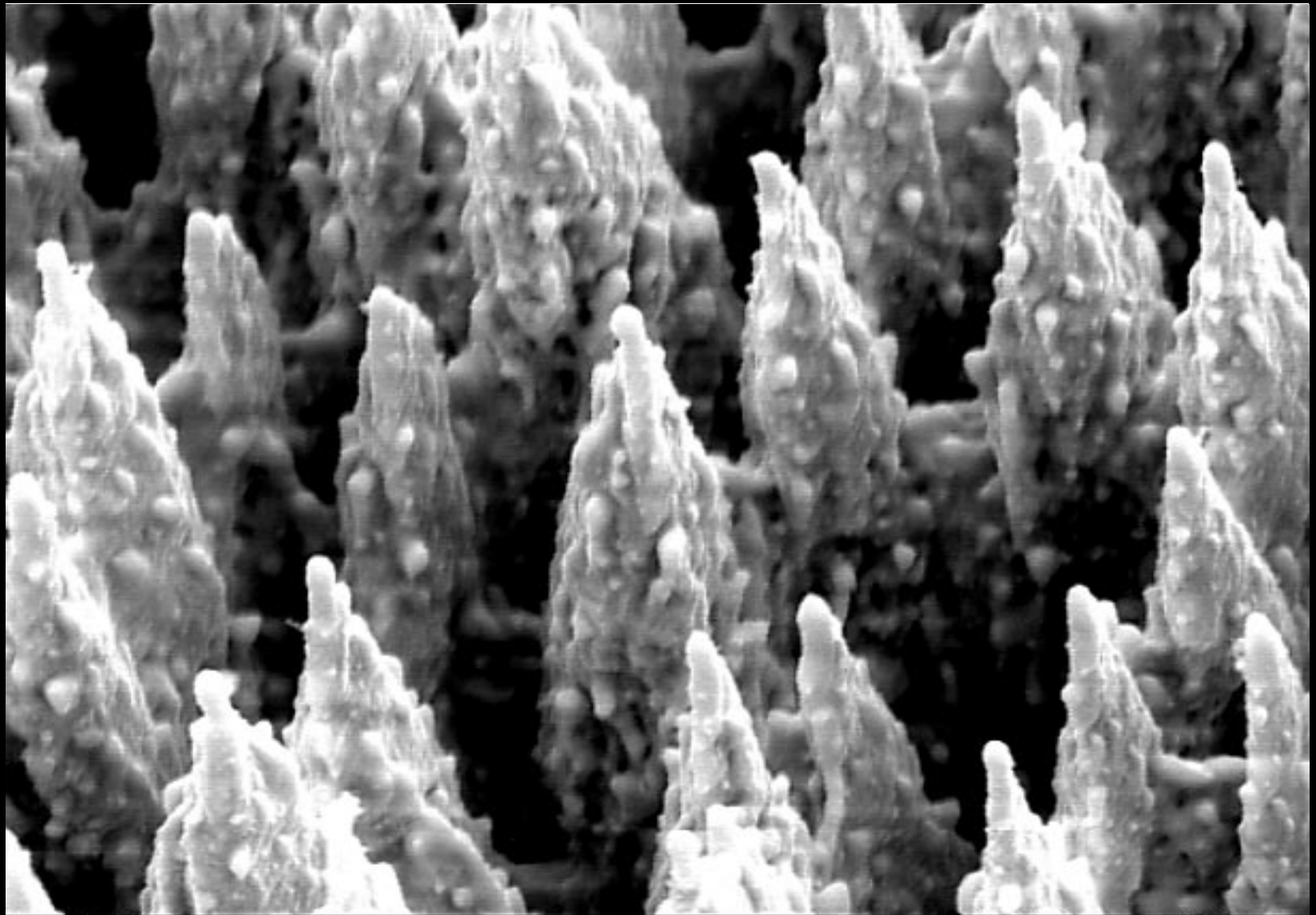
- ▶ **Novel technique for producing spikes**
- ▶ **Unity light absorption**
- ▶ **Luminescence**
- ▶ **Field emission**



Funding: Army Research Office

**For a copy of this talk and
additional information, see:**

<http://mazur-www.harvard.edu>



x5000
#3554
512 x 480

5 μ m

10kV 15mm

GERMANIUM