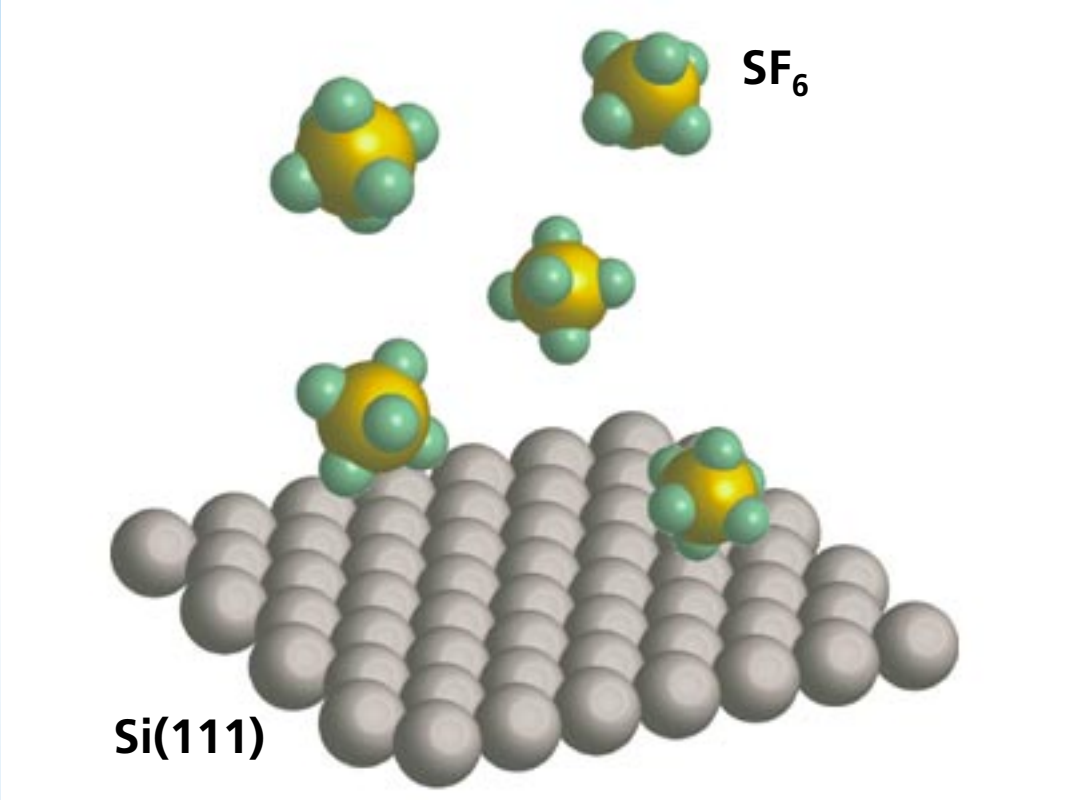
BLACK SILICON: A NEW LIGHT ABSORBER

Claudia Wu
Tsing-Hua Her
Eric Mazur
Harvard University

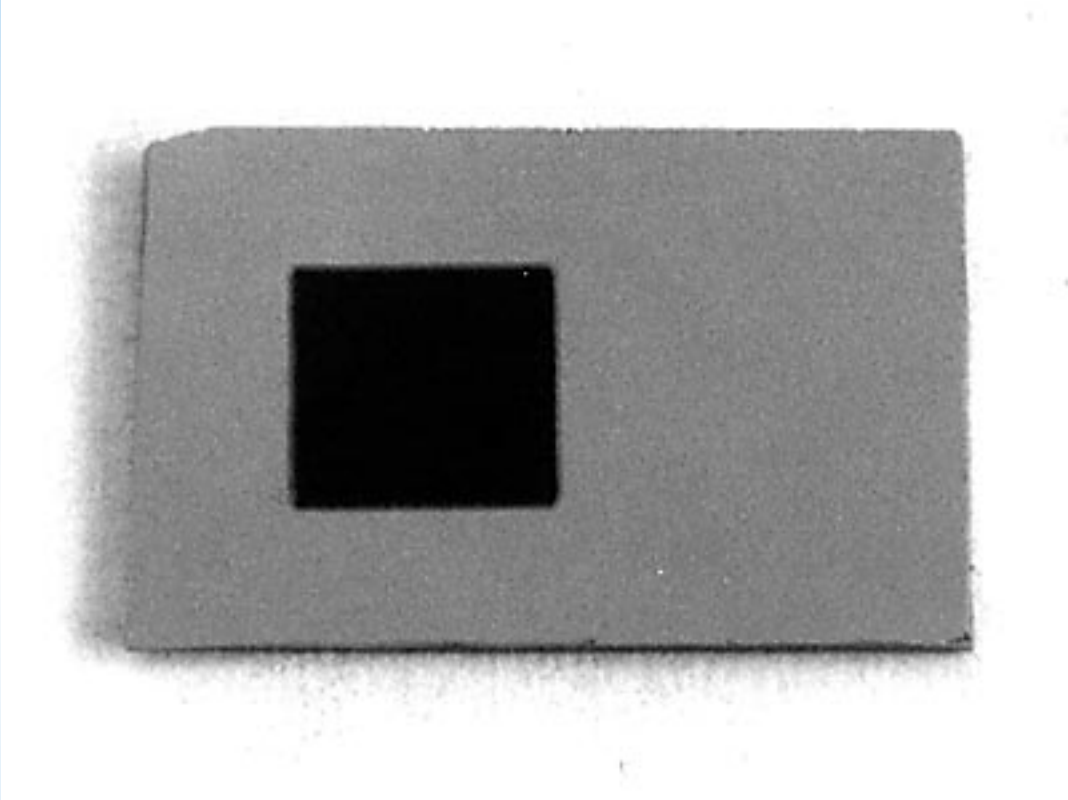
APS Centennial Meeting
23 March1999

Introduction



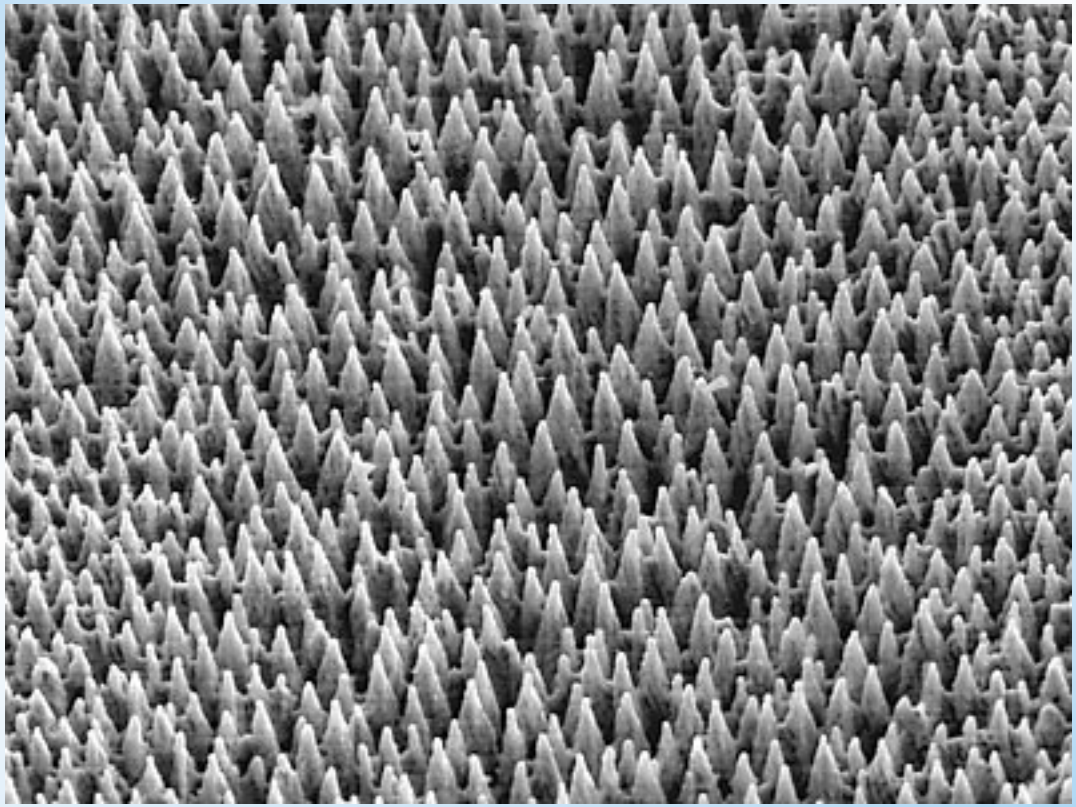
irradiate with 100 fs 10 kJ/m^2 laser pulses

Introduction



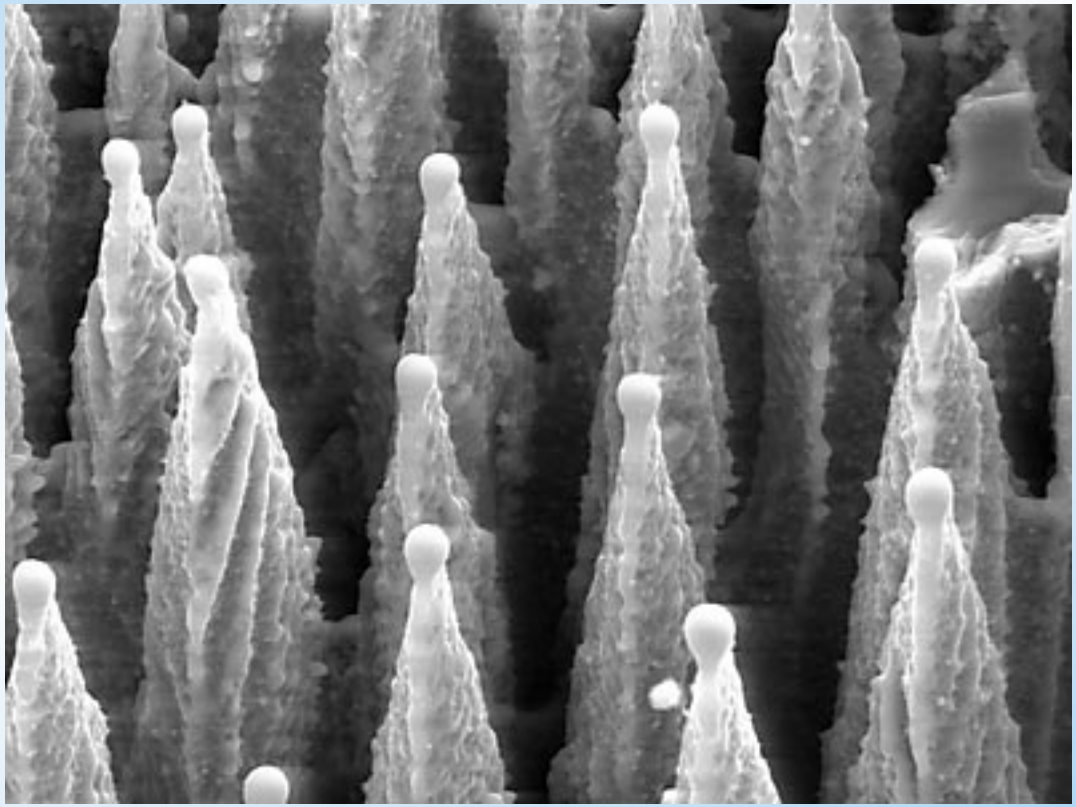
5 mm

Introduction



20 μm

Introduction



4 µm

Outline

- **Conditions for formation**

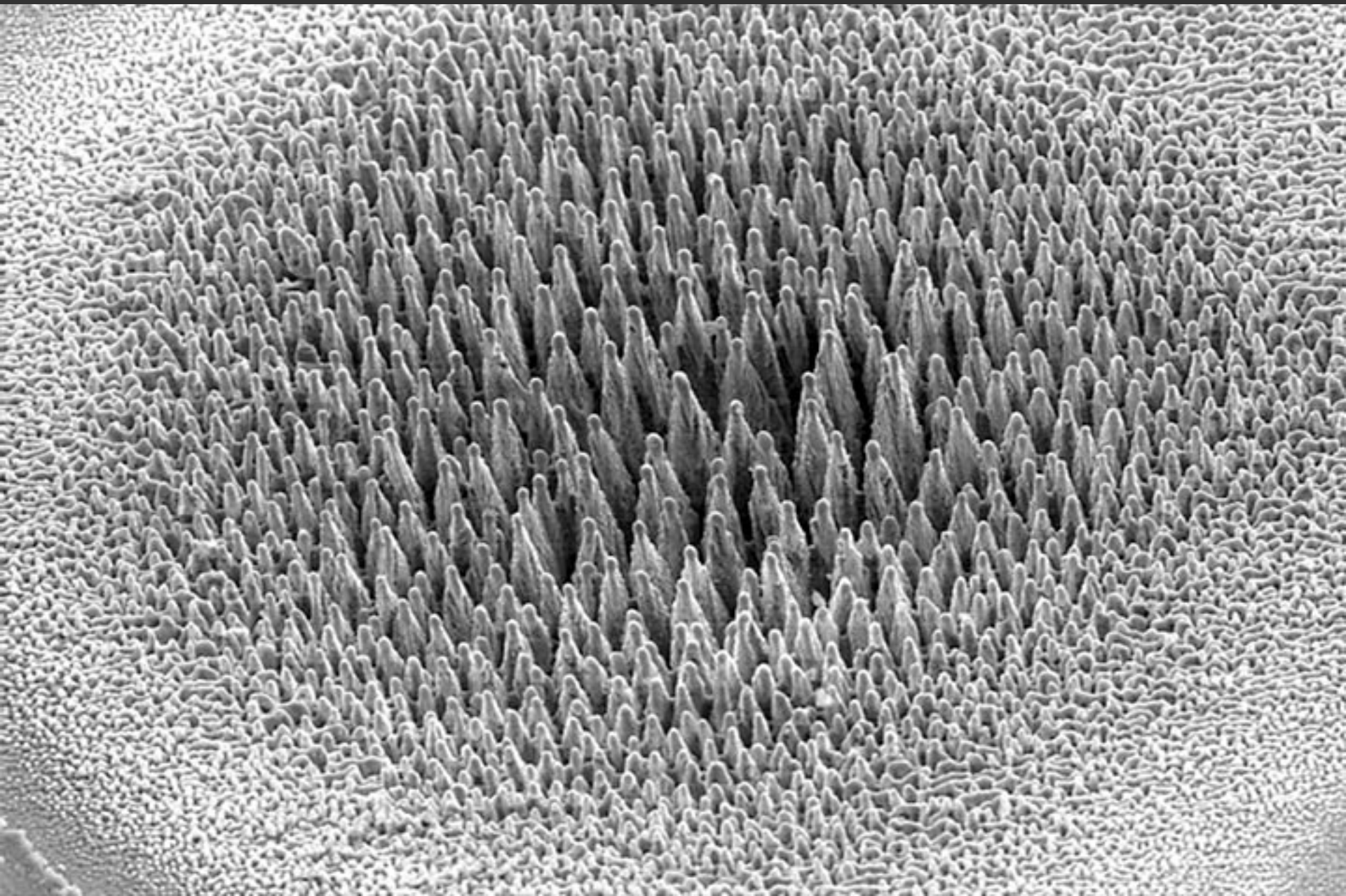
Outline

- **Conditions for formation**
- **Mechanism**

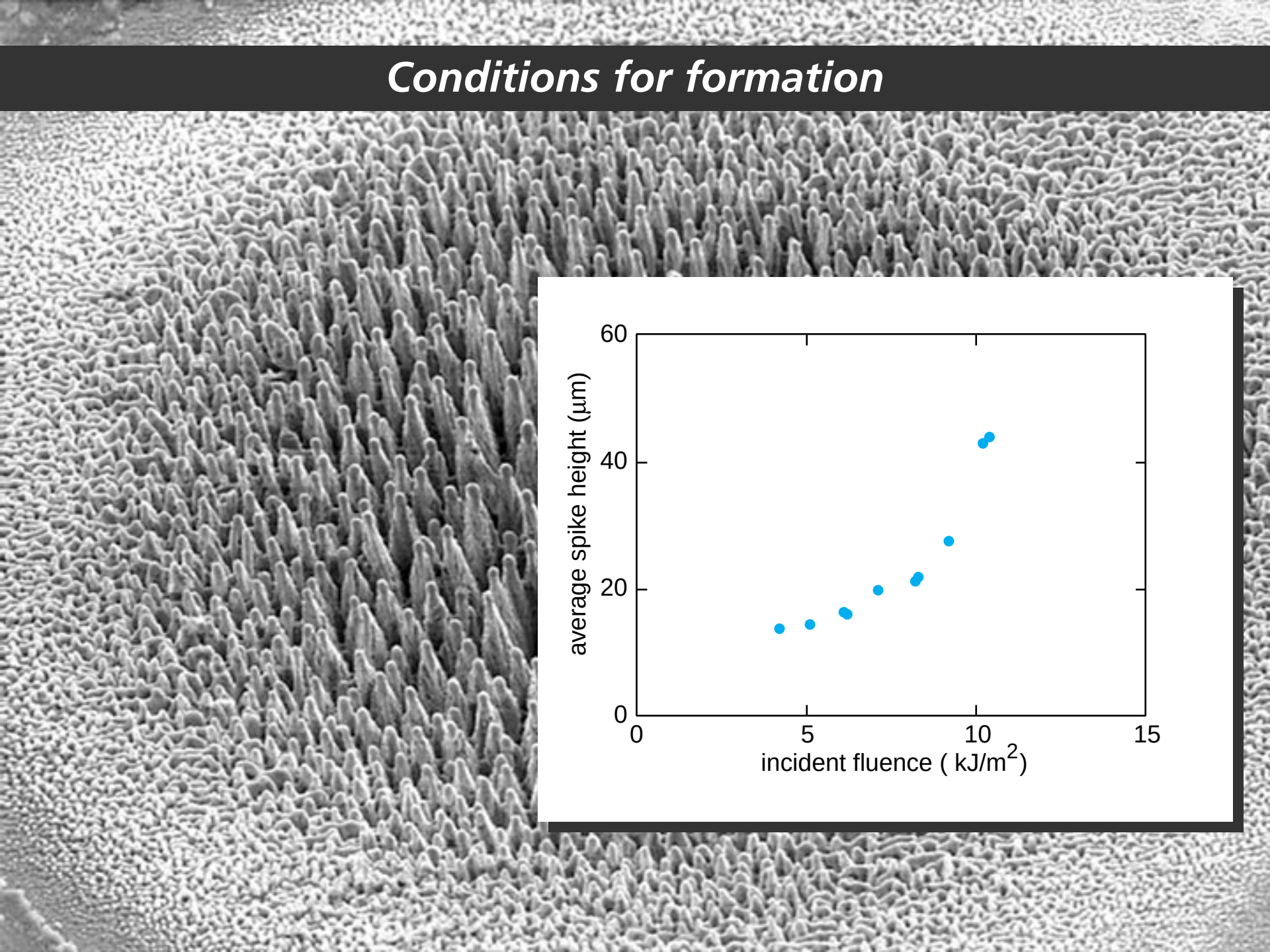
Outline

- **Conditions for formation**
- **Mechanism**
- **Light absorption**

Conditions for formation

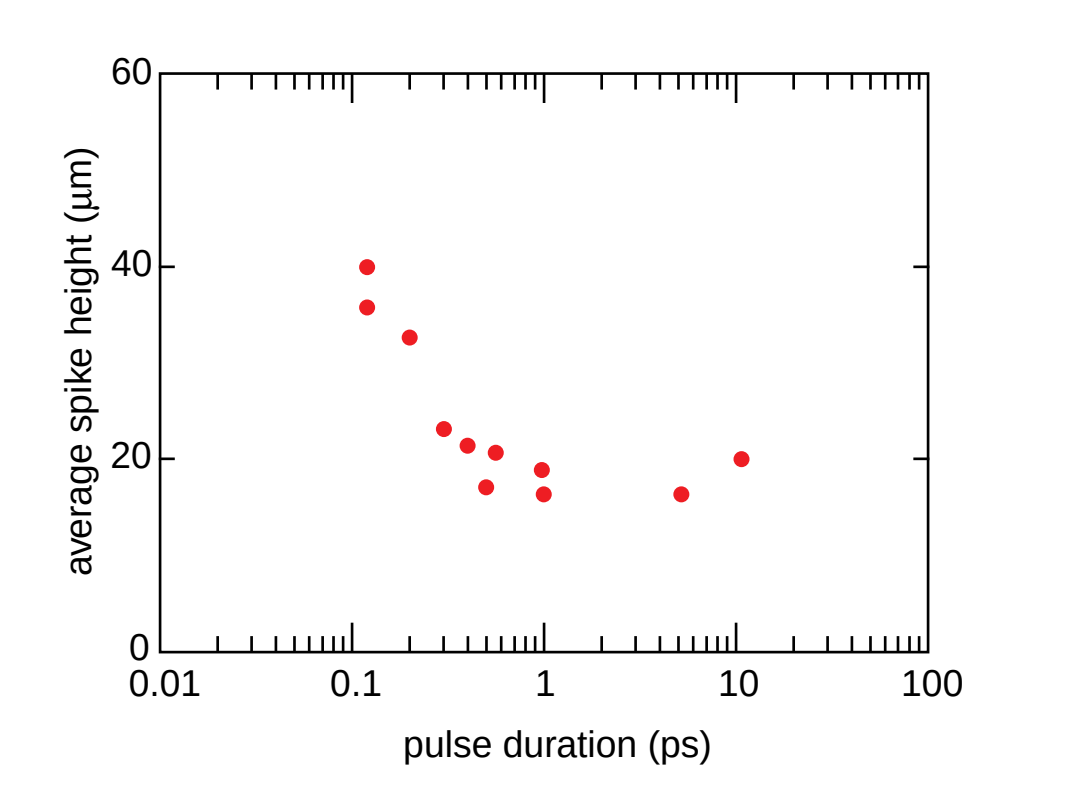


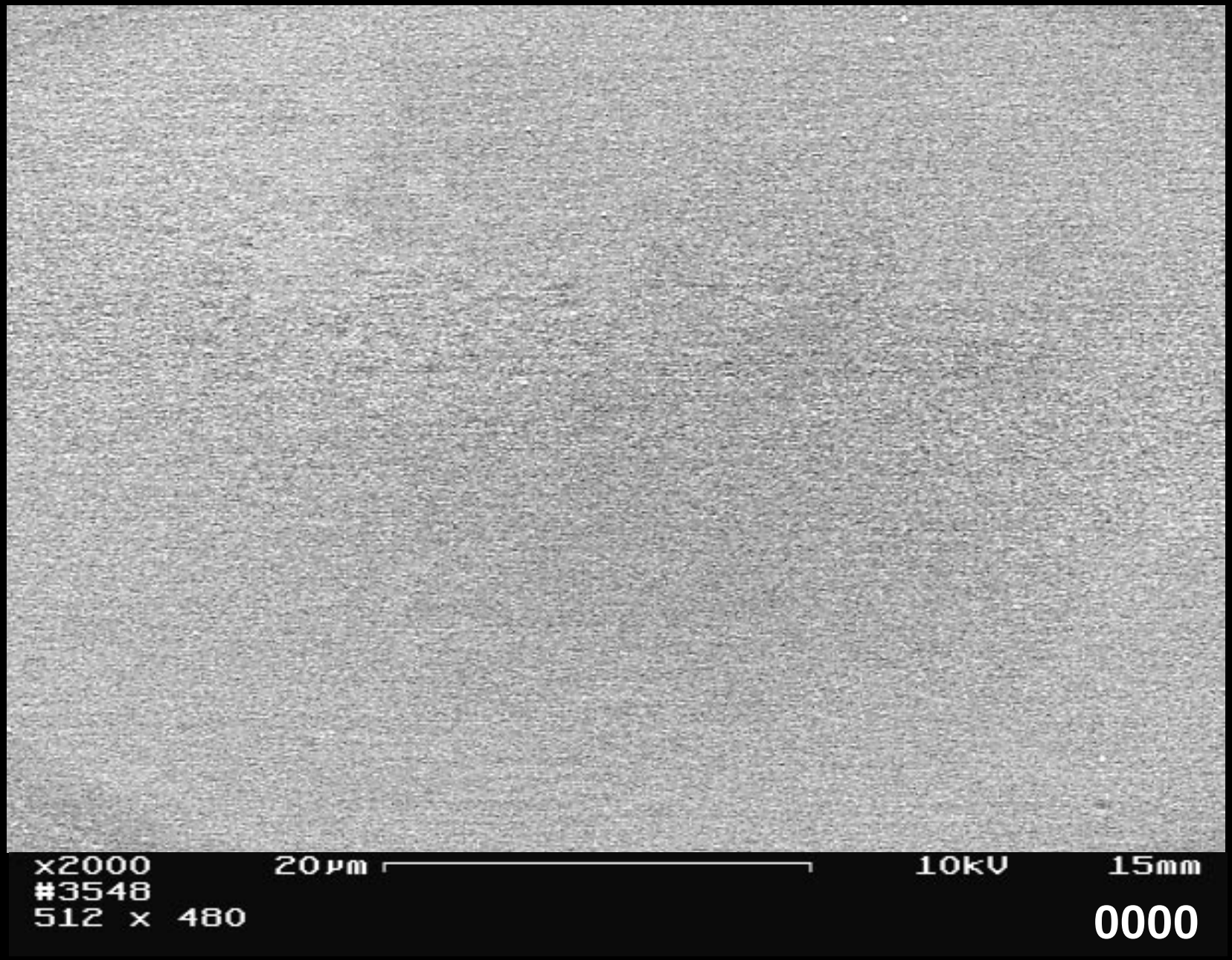
Conditions for formation

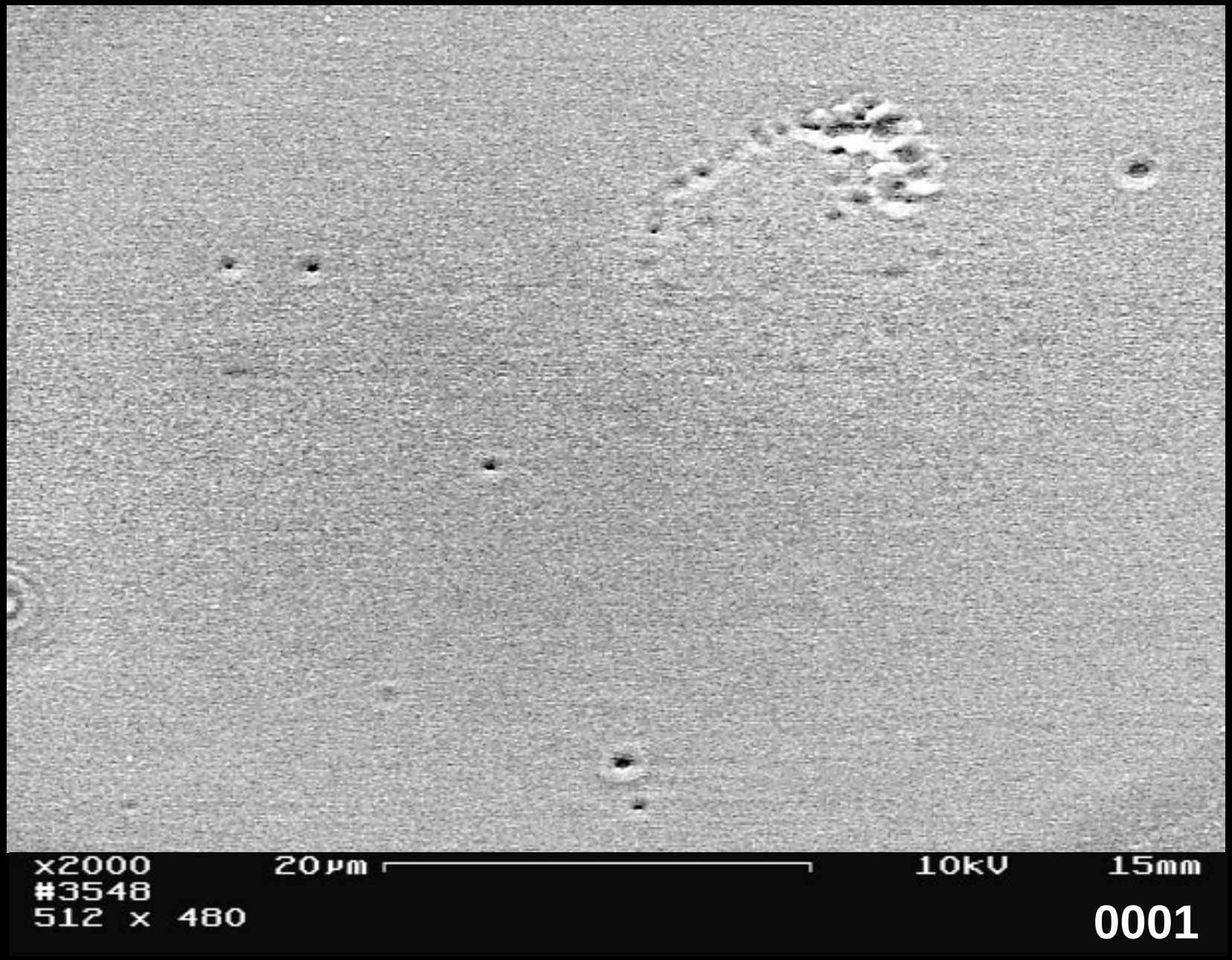


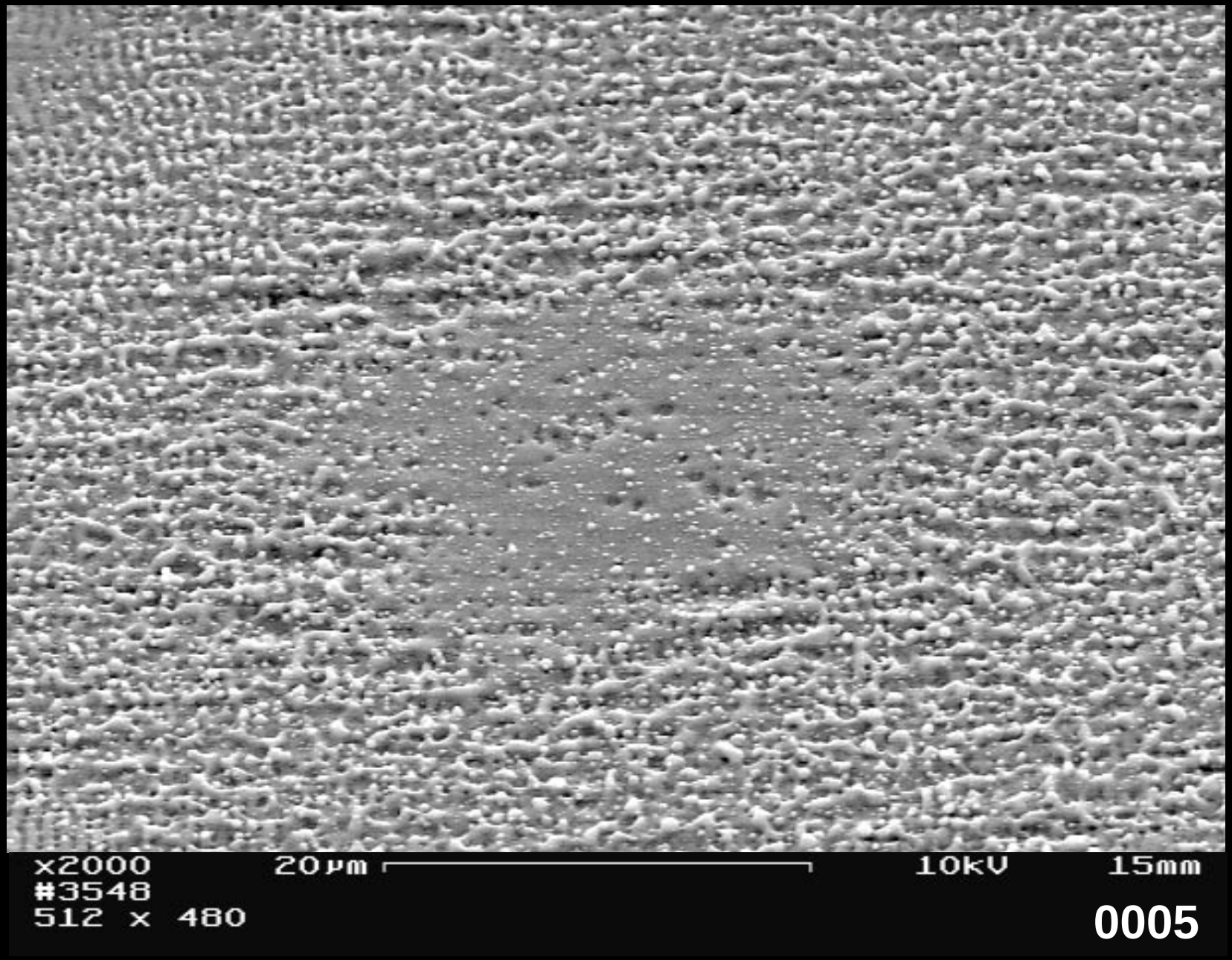
Conditions for formation

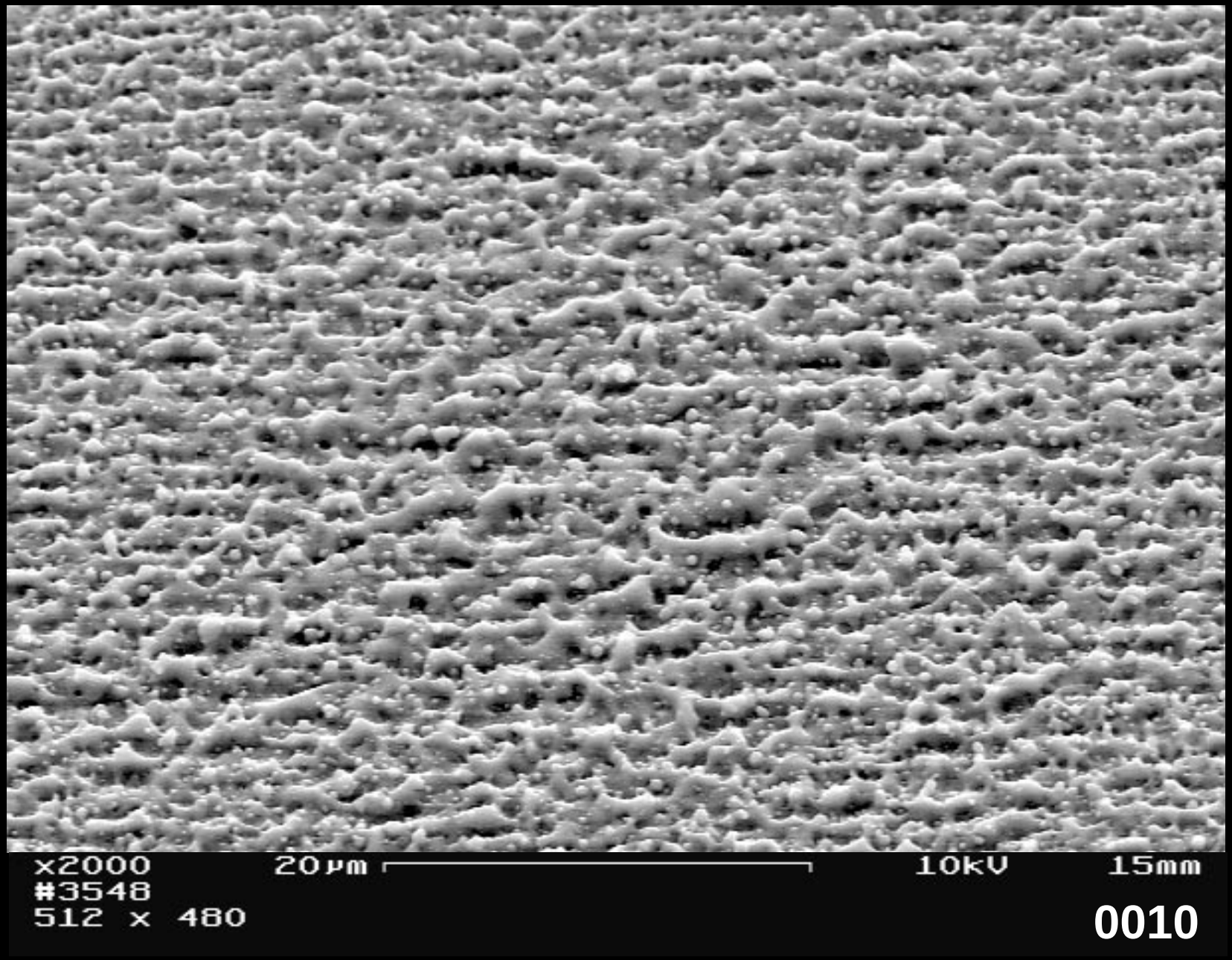
pulse duration dependence

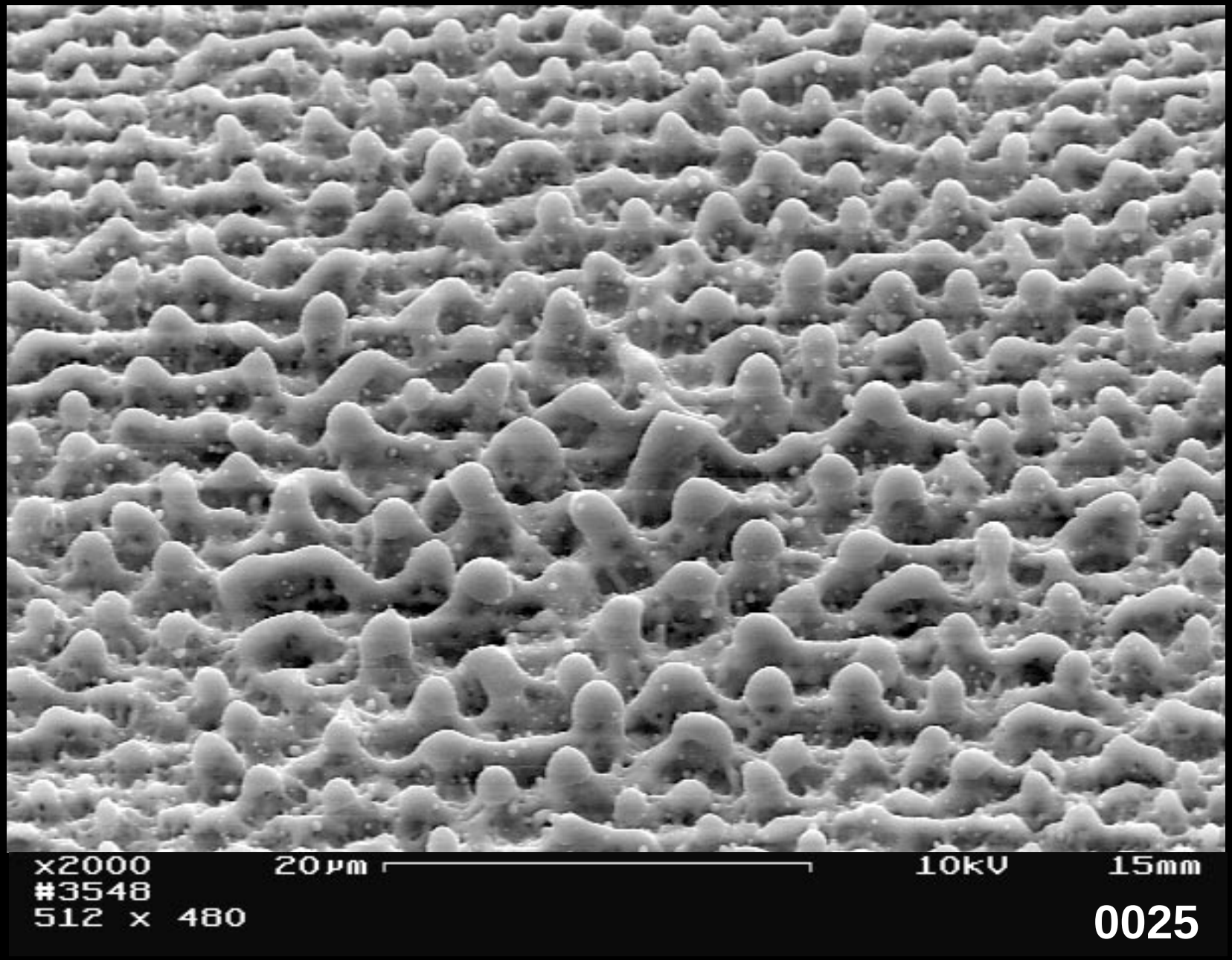


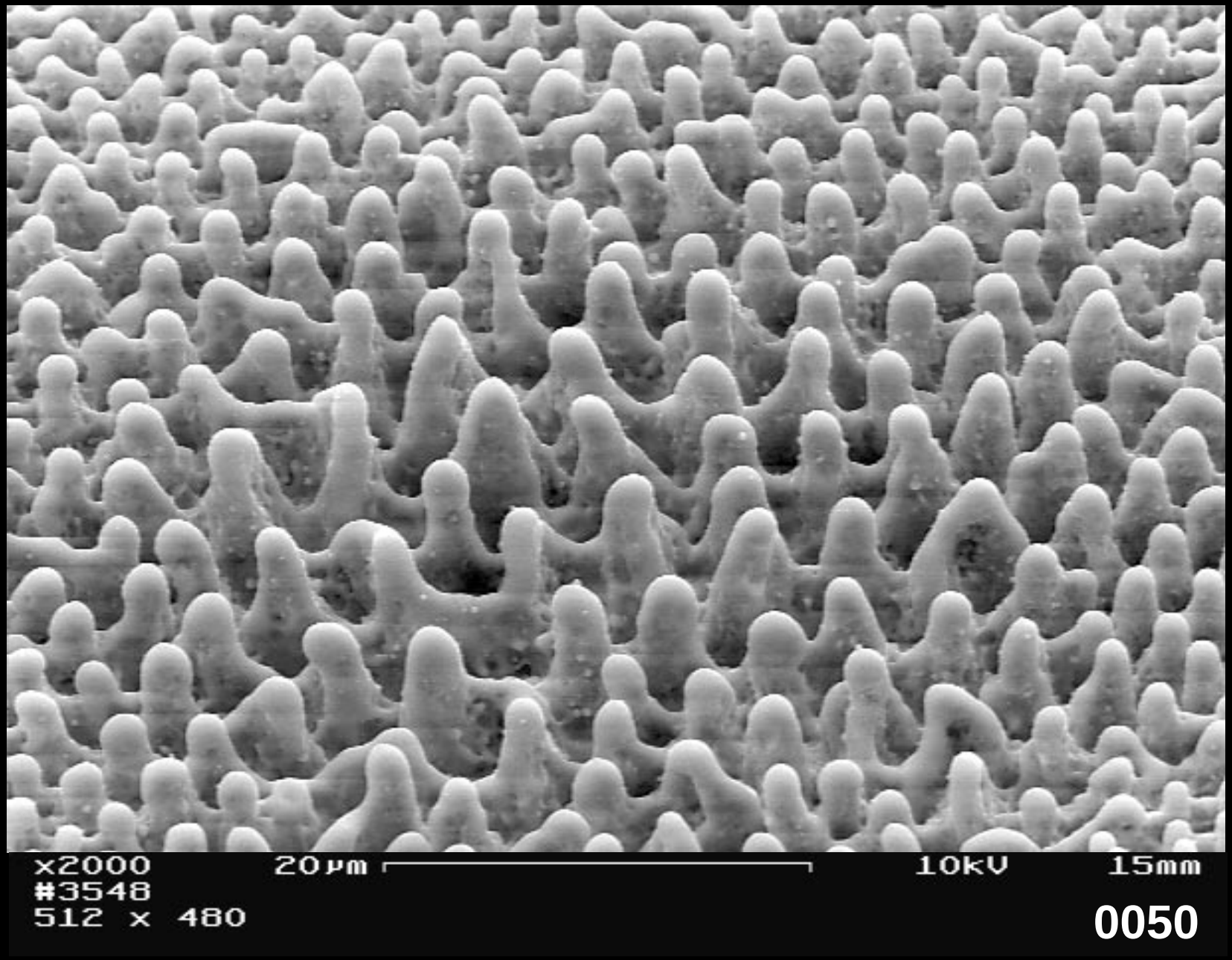

x2000
20µm
10kV
15mm
#3548
512 x 480
0000

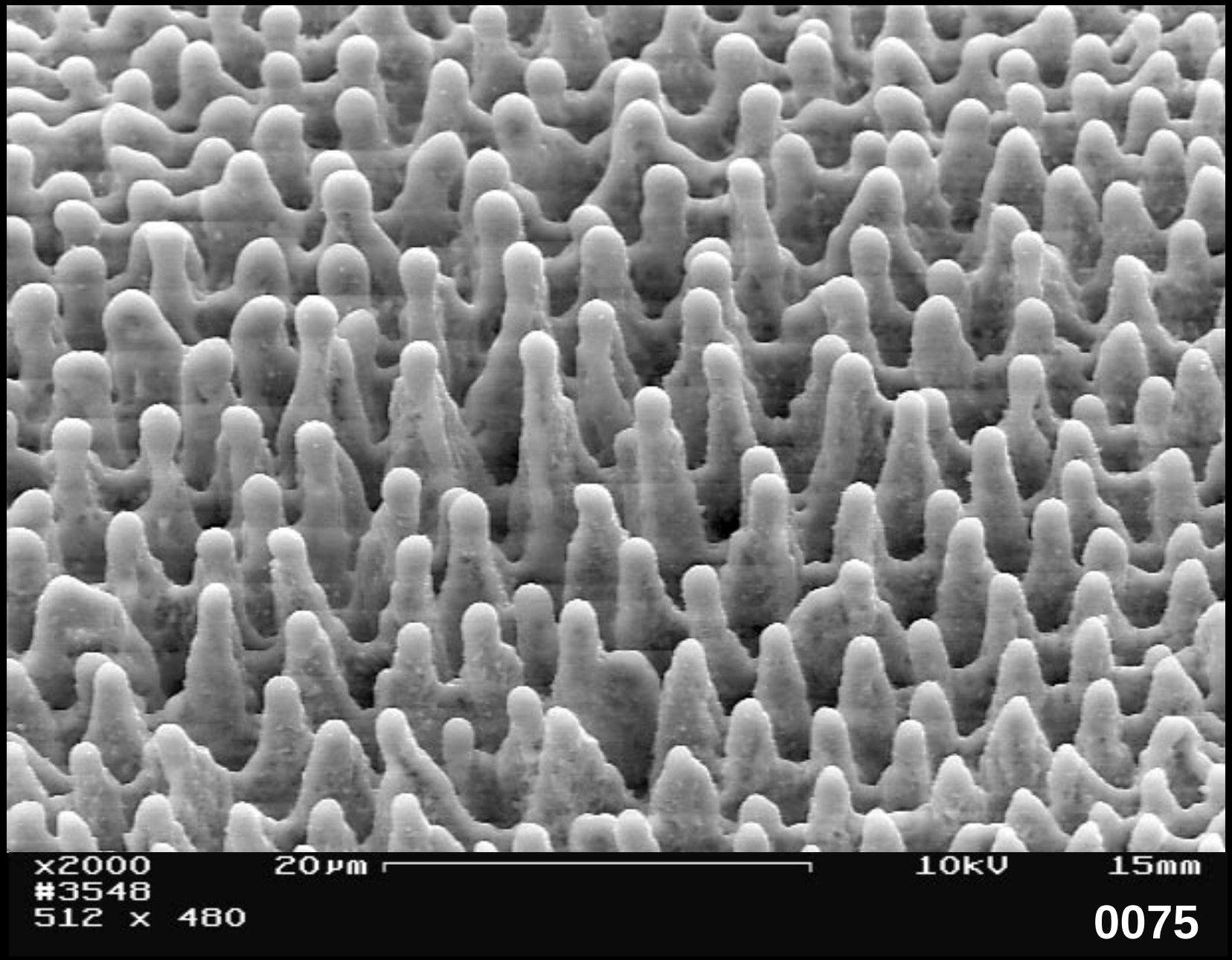

x2000
20µm
10kV
15mm
#3548
512 x 480
0001

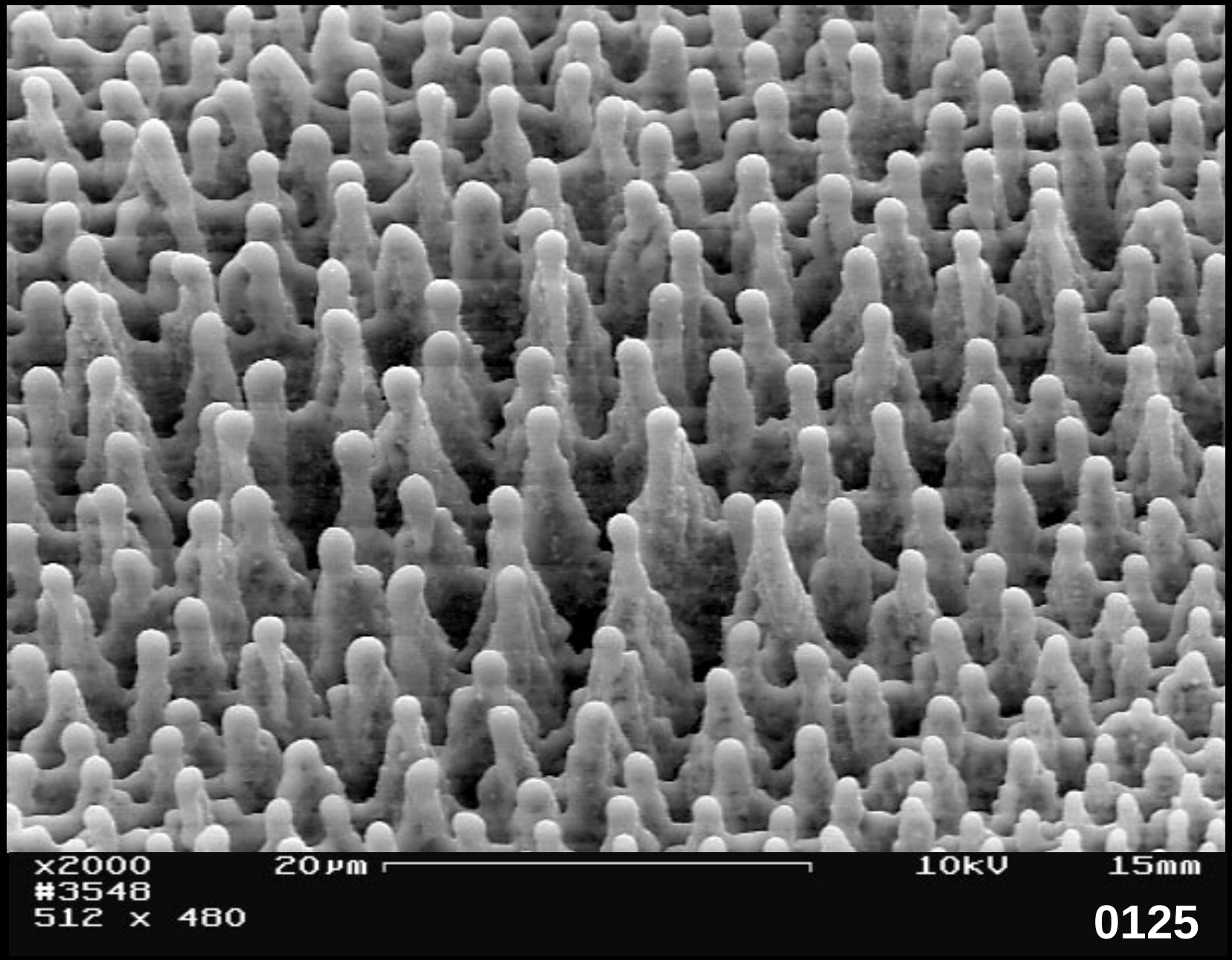

x2000
20µm
10kV
15mm
#3548
512 x 480
0005

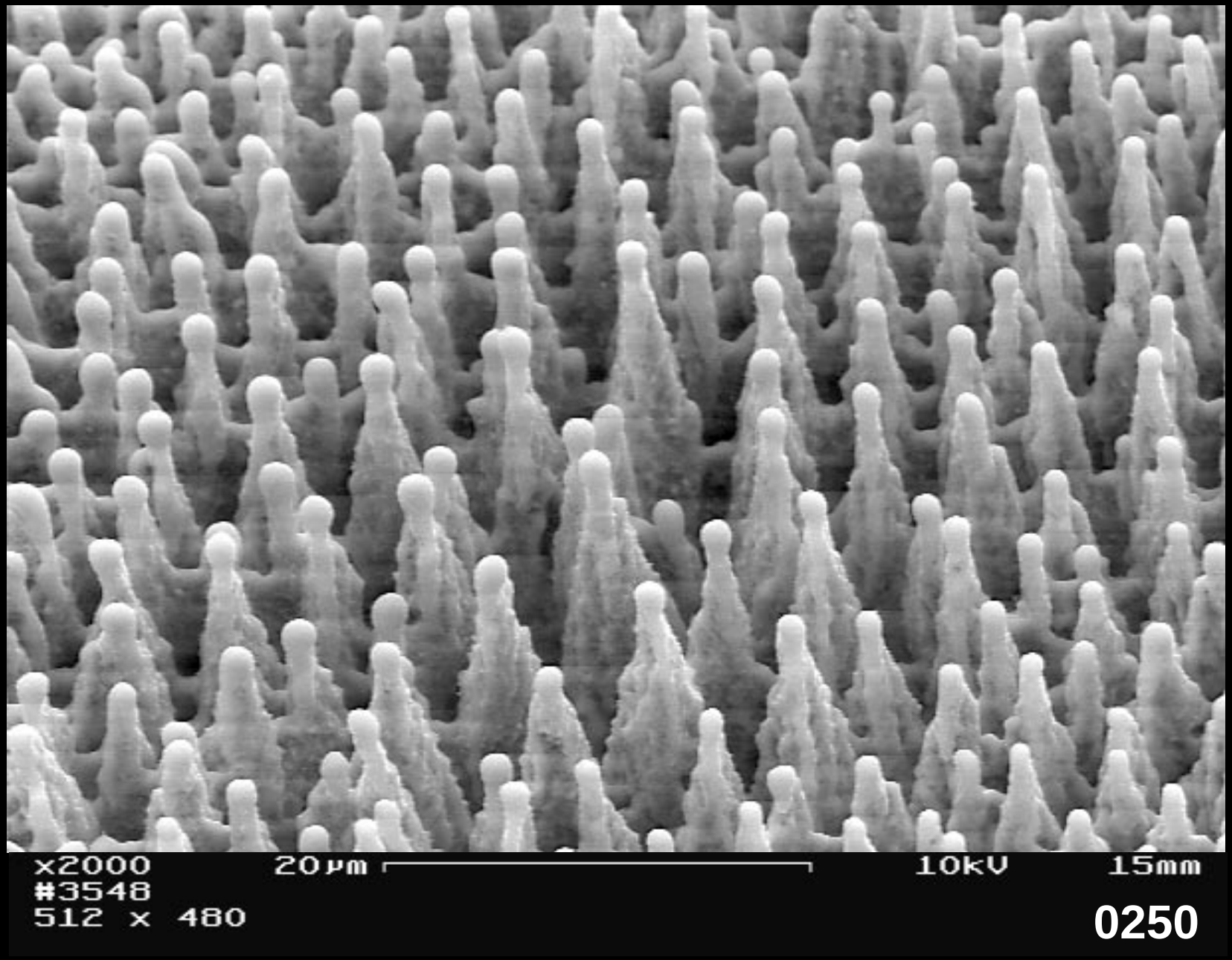

x2000
20µm
10kV
15mm
#3548
512 x 480
0010

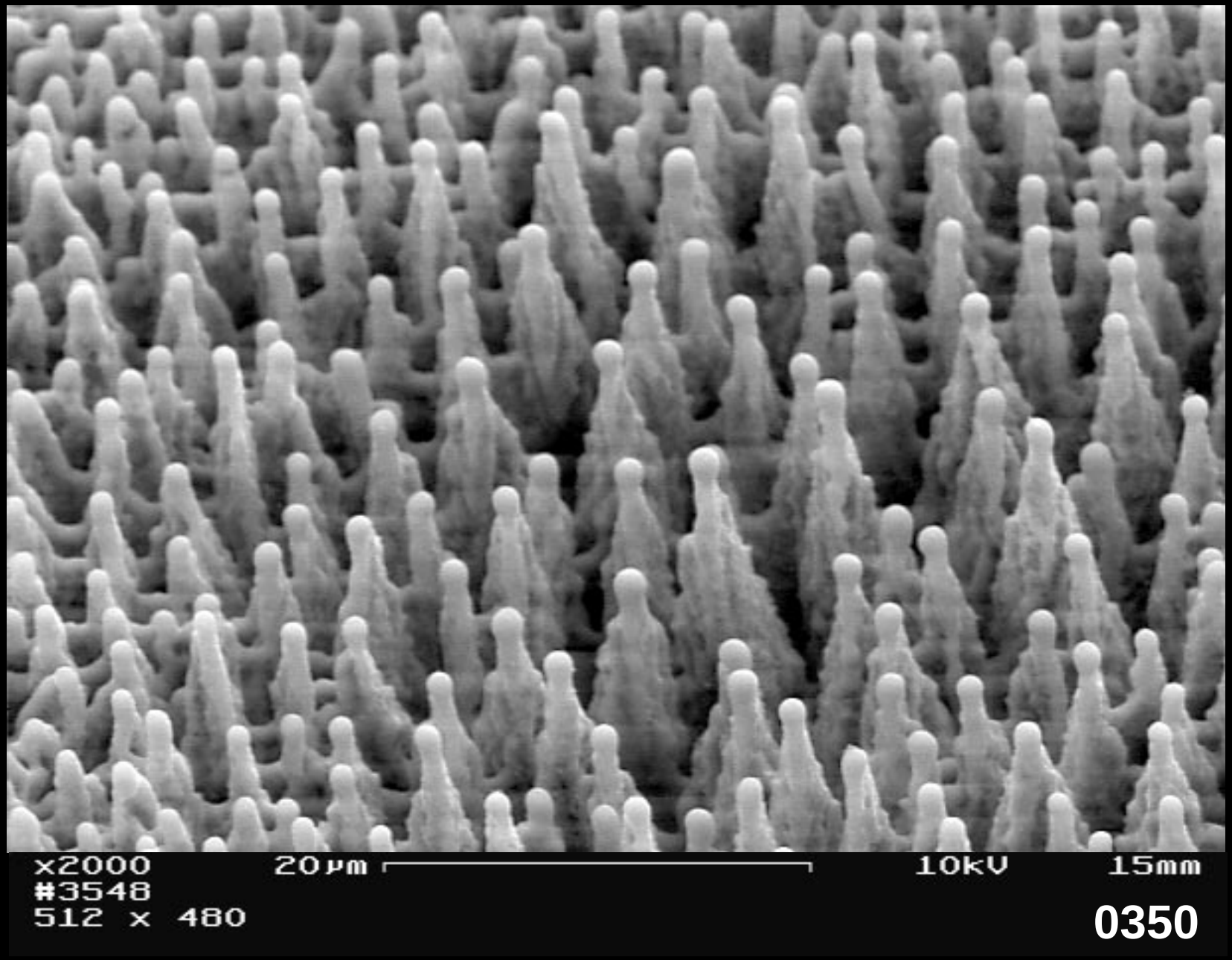

x2000
20µm
10kV
15mm
#3548
512 x 480
0025

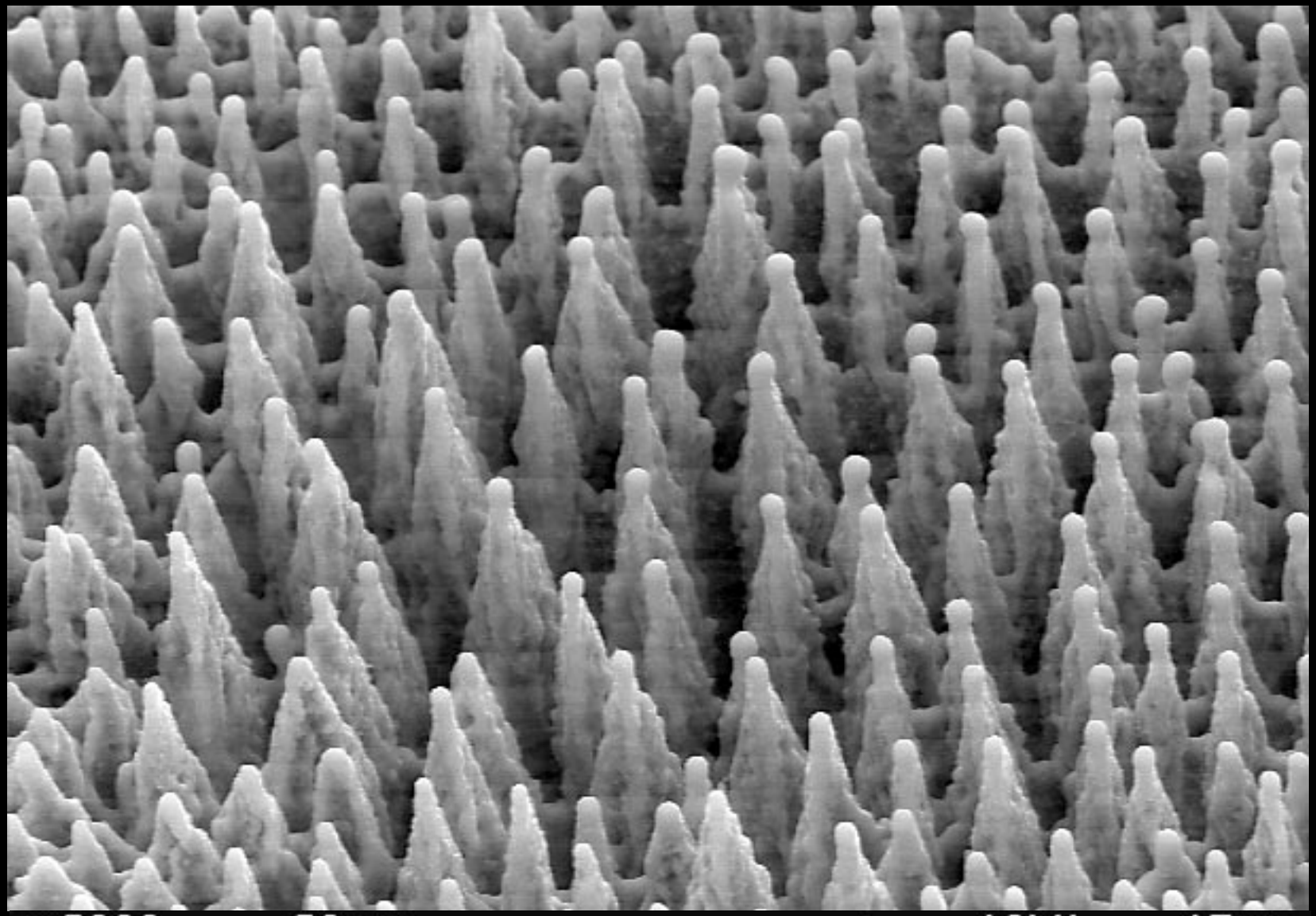

x2000
#3548
512 x 480
20µm
10kV
15mm
0050


x2000
#3548
512 x 480
20µm
10kV
15mm
0075

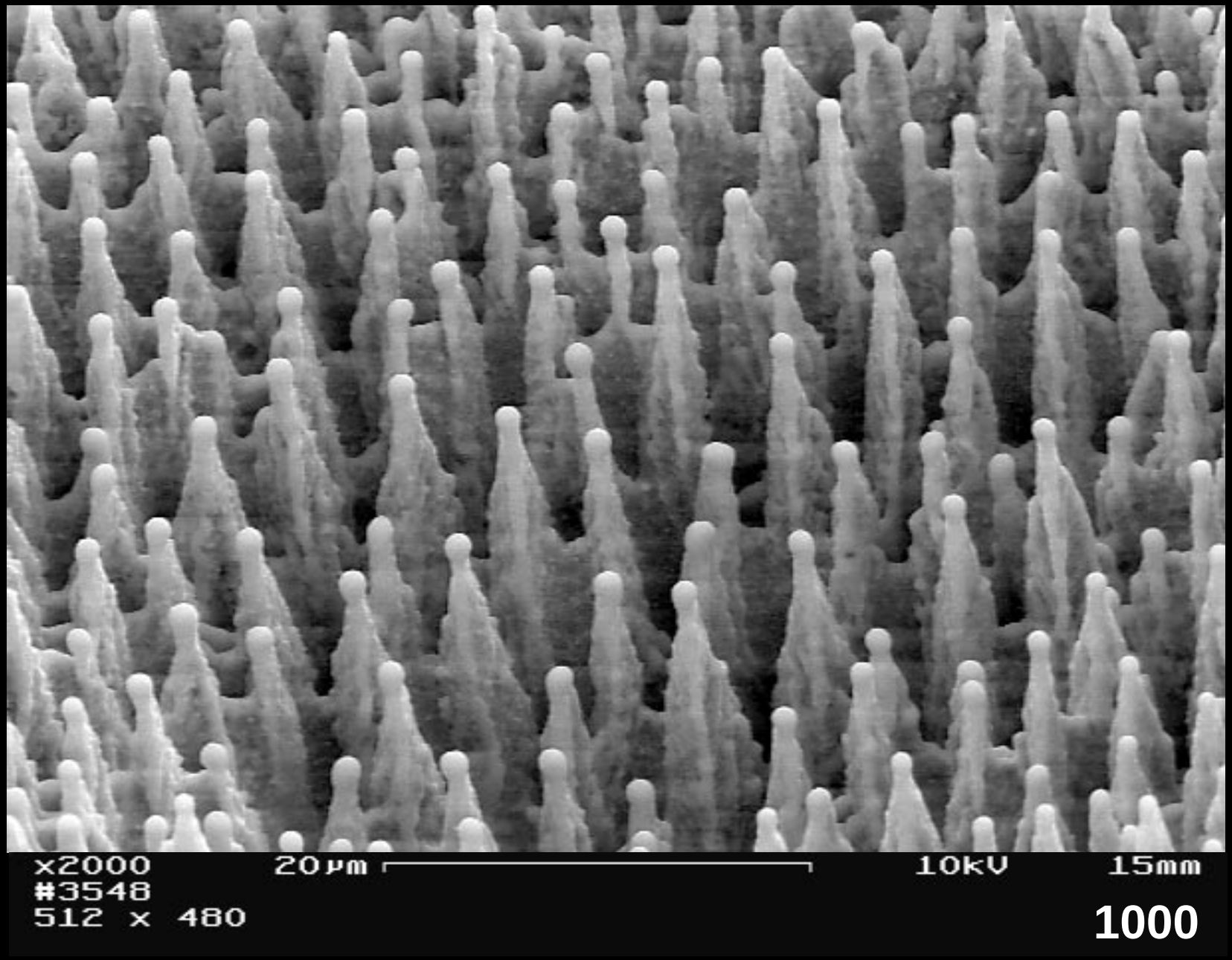

x2000
#3548
512 x 480
20µm
10kV
15mm
0125


x2000
#3548
512 x 480
20µm
10kV
15mm
0250

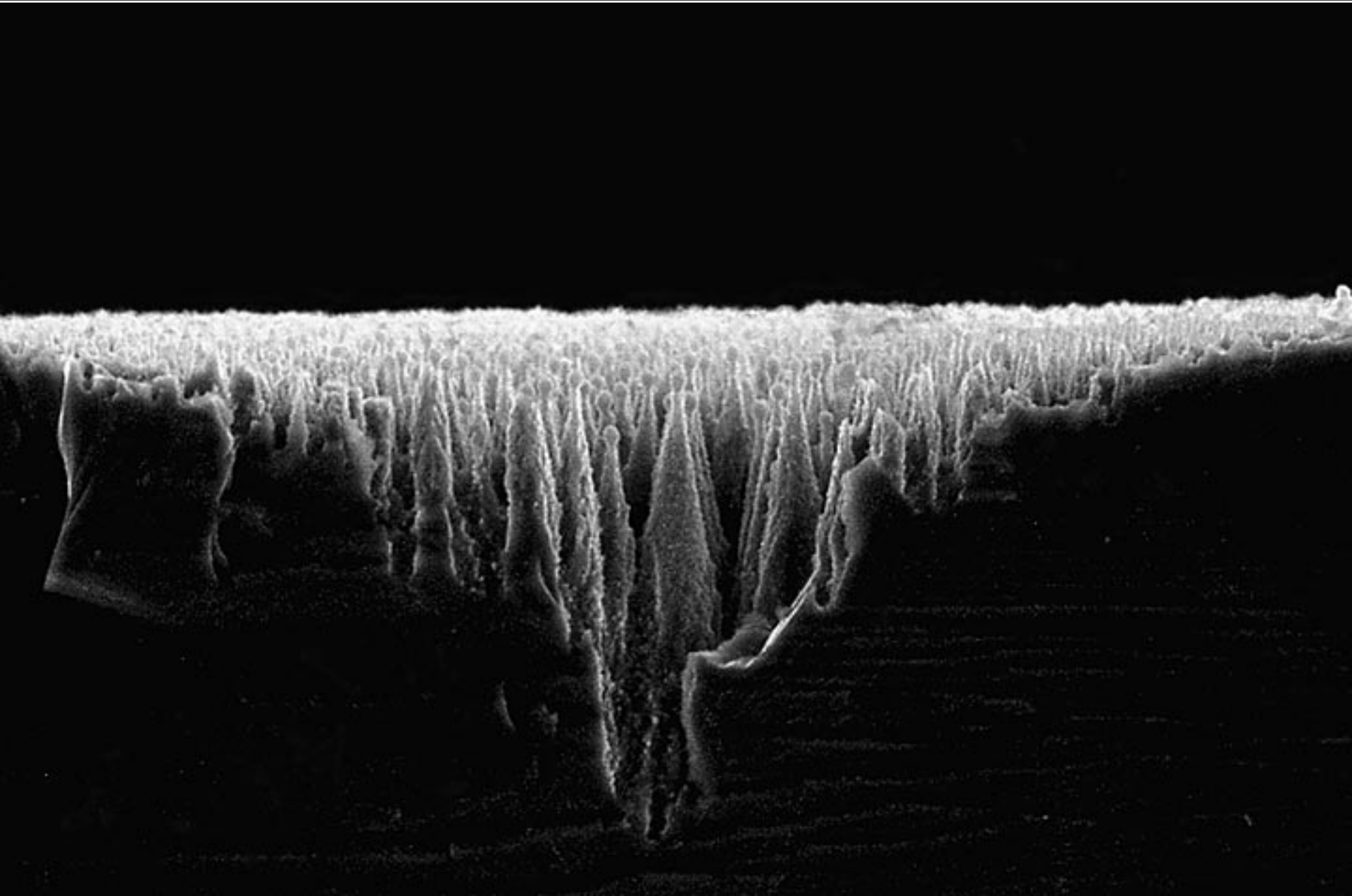

x2000
#3548
512 x 480
20µm
10kV
15mm
0350



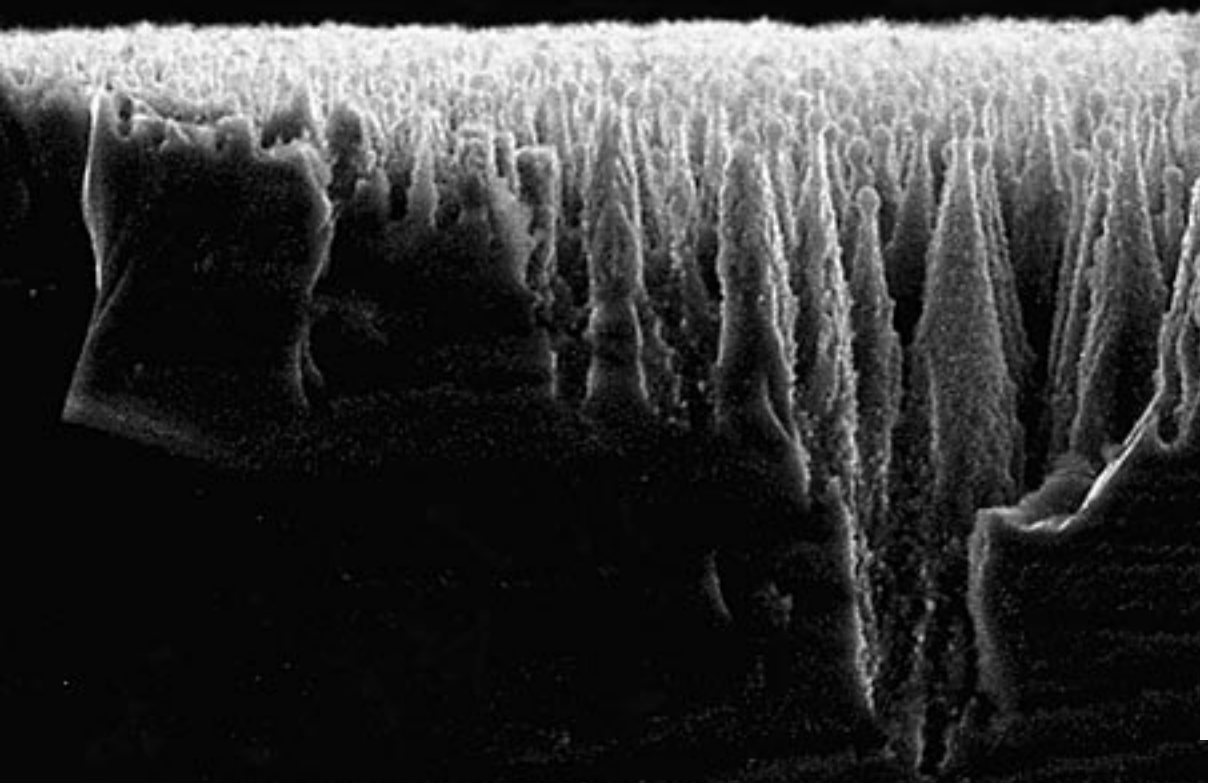
0450

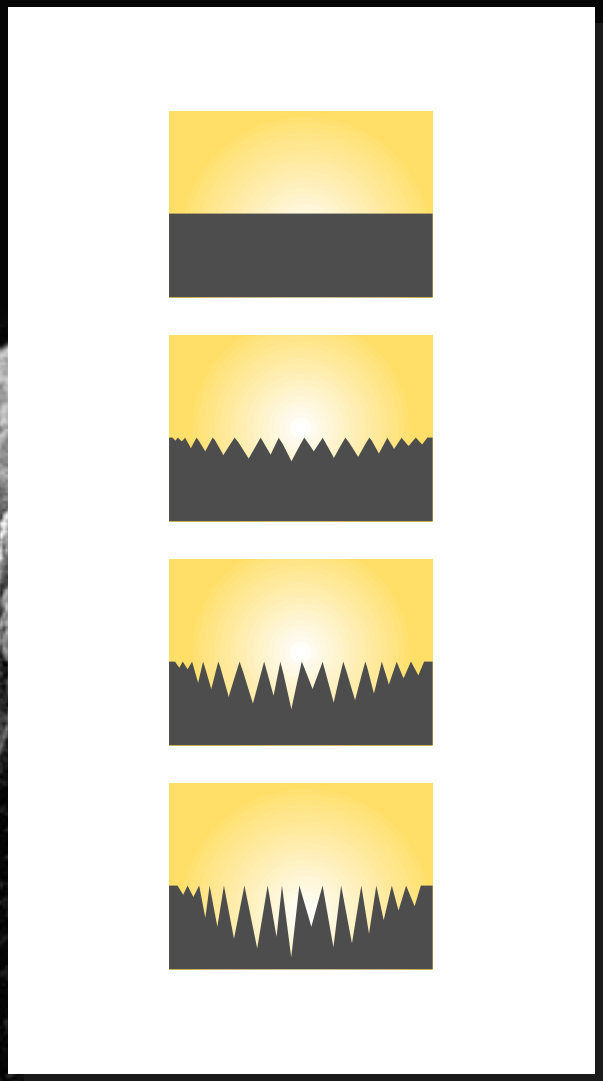

x2000
#3548
512 x 480
20µm
10kV
15mm
1000

Mechanism

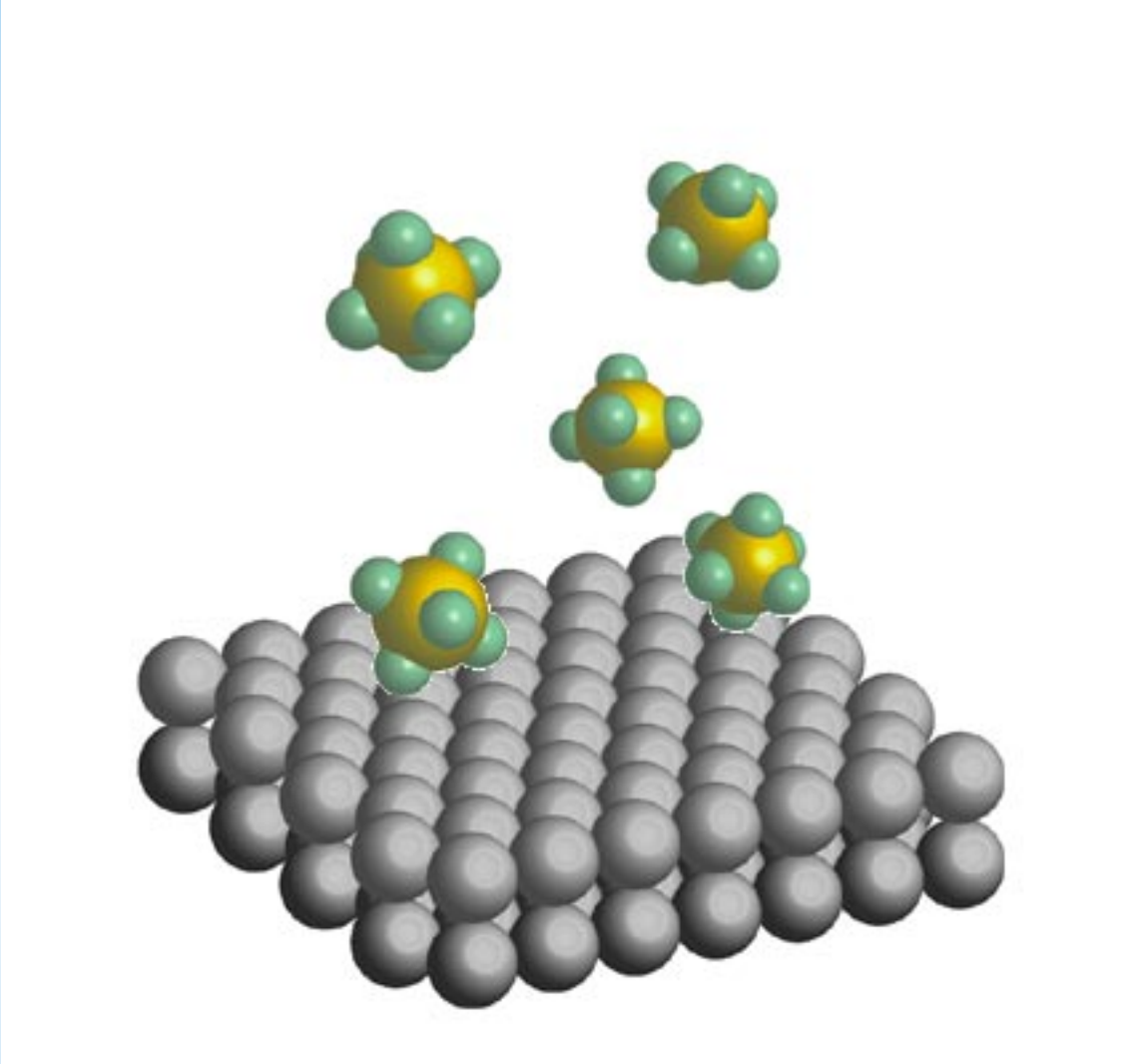


Mechanism

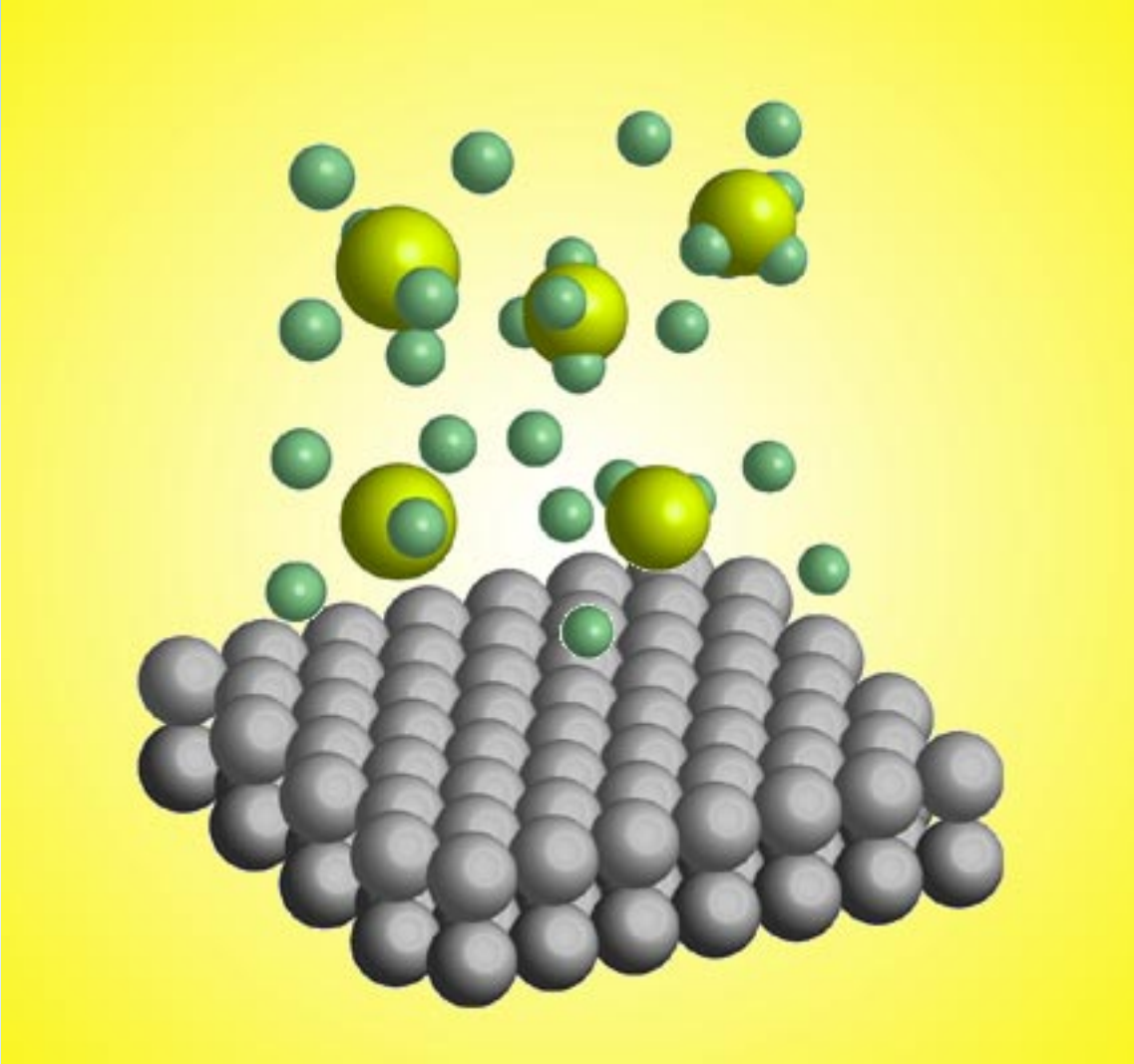




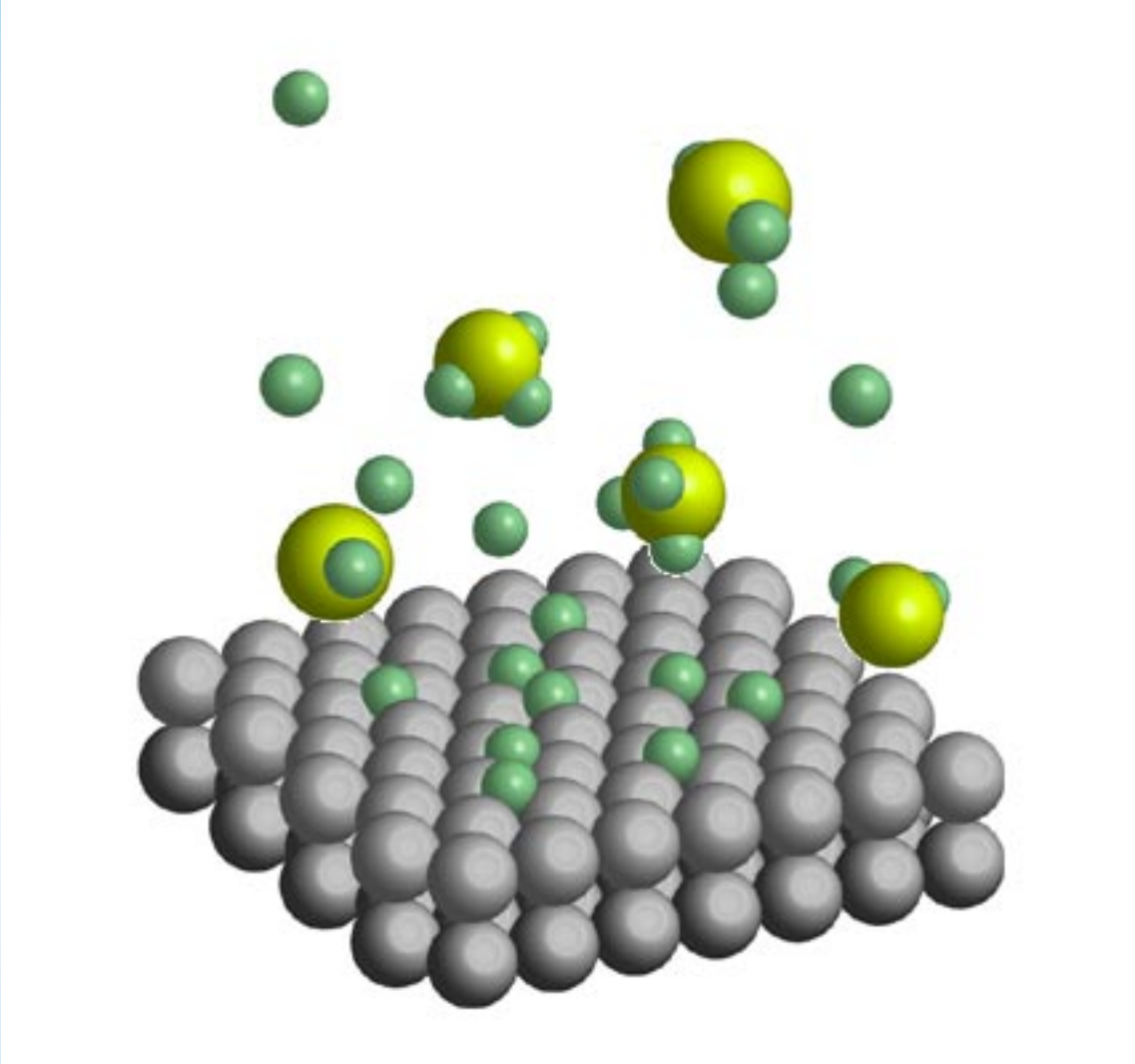
Mechanism



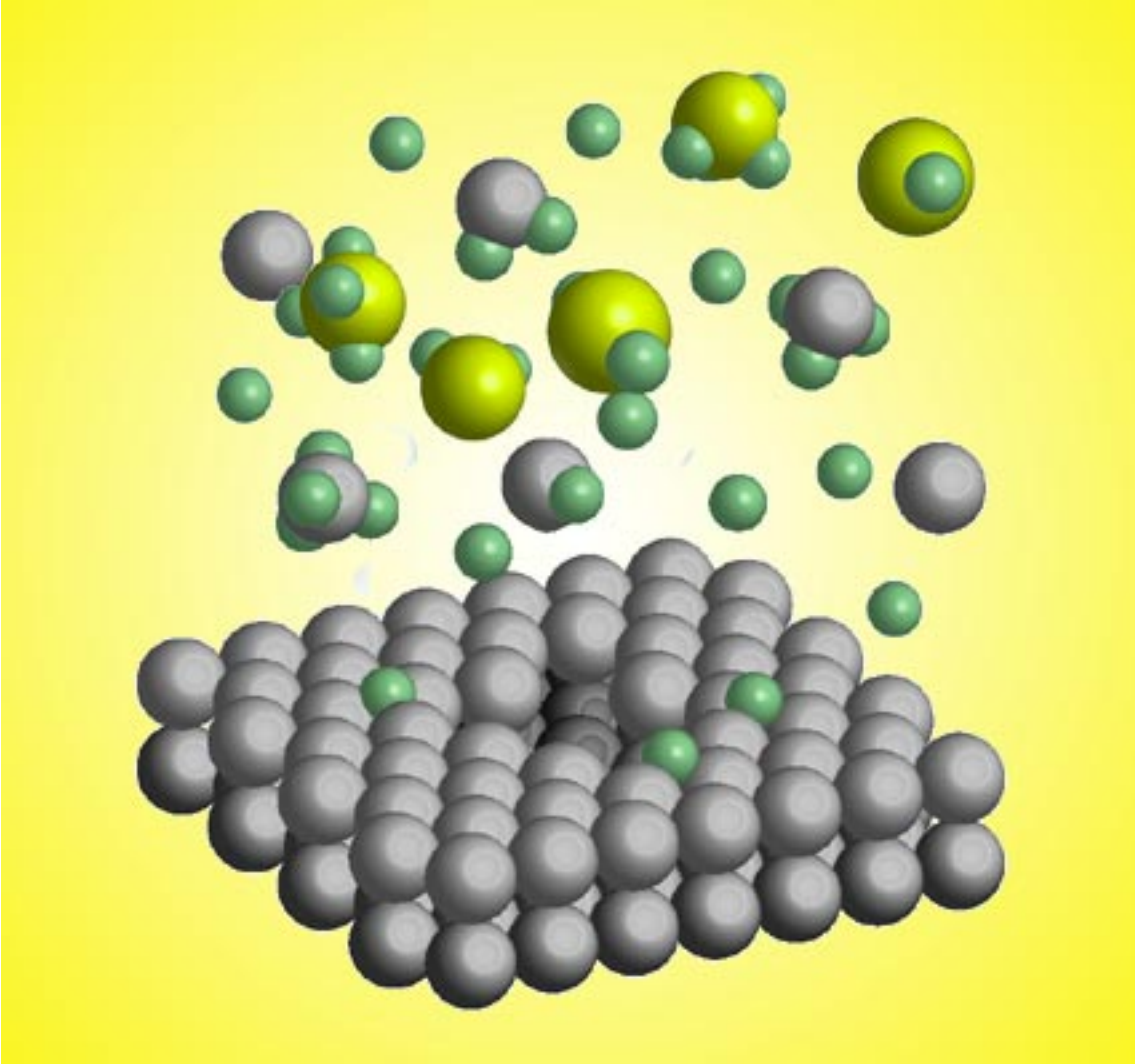
Mechanism



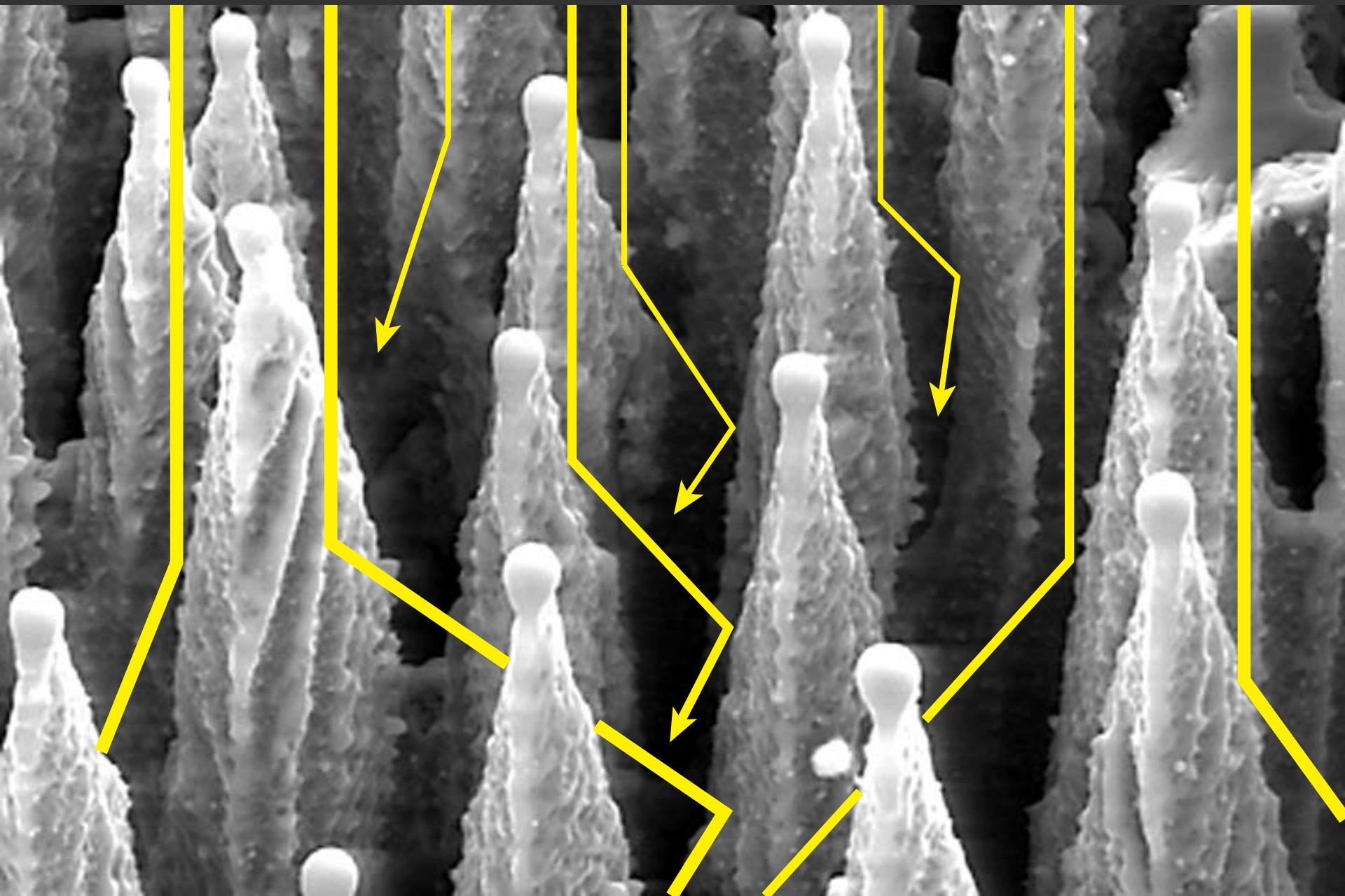
Mechanism



Mechanism



Light absorption



Light absorption

	normal Si	black Si
400 nm	0.52	
600 nm	0.60	
800 nm	0.67	

Light absorption

	normal Si	black Si
400 nm	0.52	1.00
600 nm	0.60	0.96
800 nm	0.67	0.80

Summary

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

Potential applications

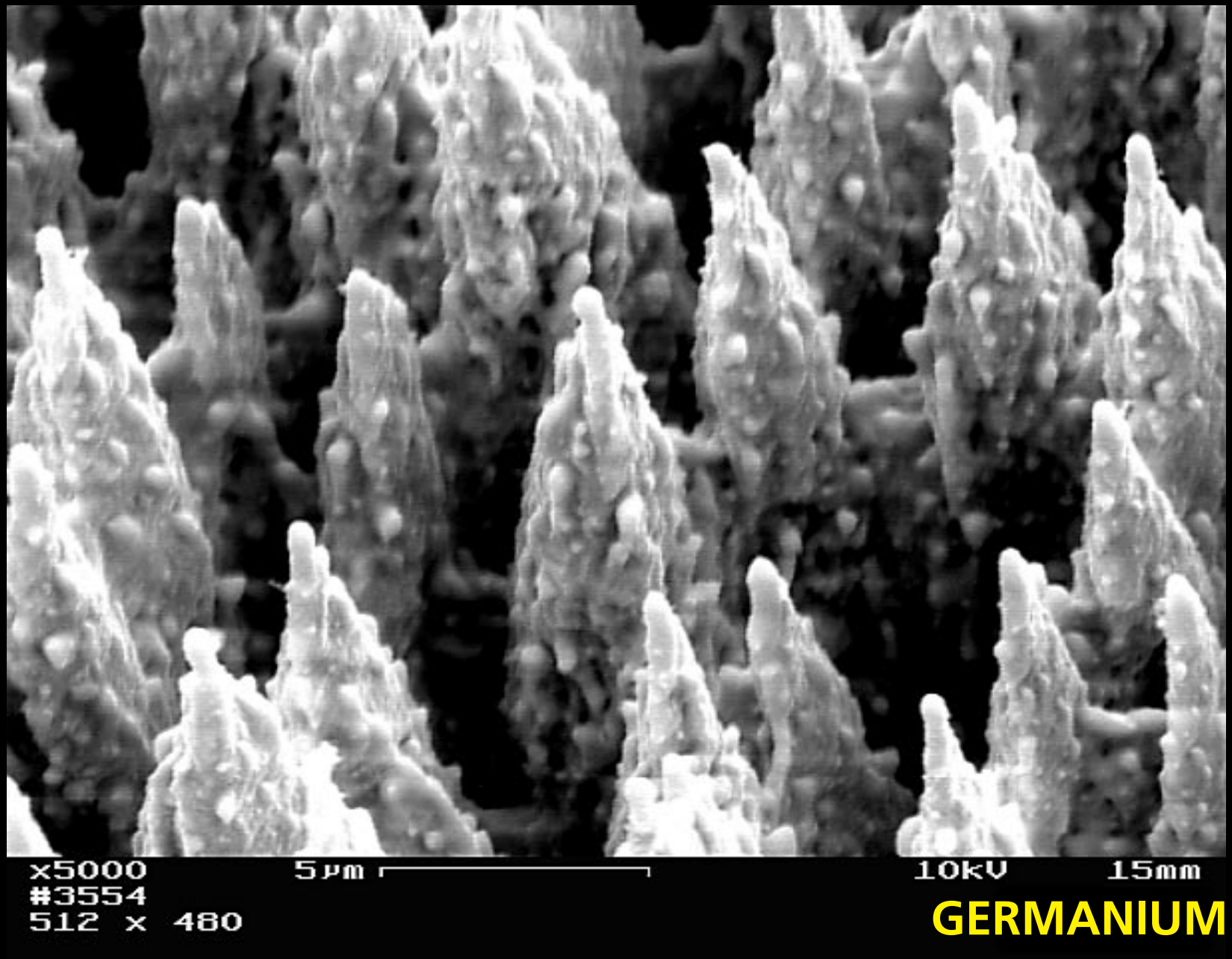
- **Photovoltaics**
- **Display technology**
- **Medicine**

Funding: Army Research Office

For a copy of this talk and

additional information, see:

http://mazur-www.harvard.edu


x5000
#3554
512 x 480
5μm
10kV
15mm
GERMANIUM