

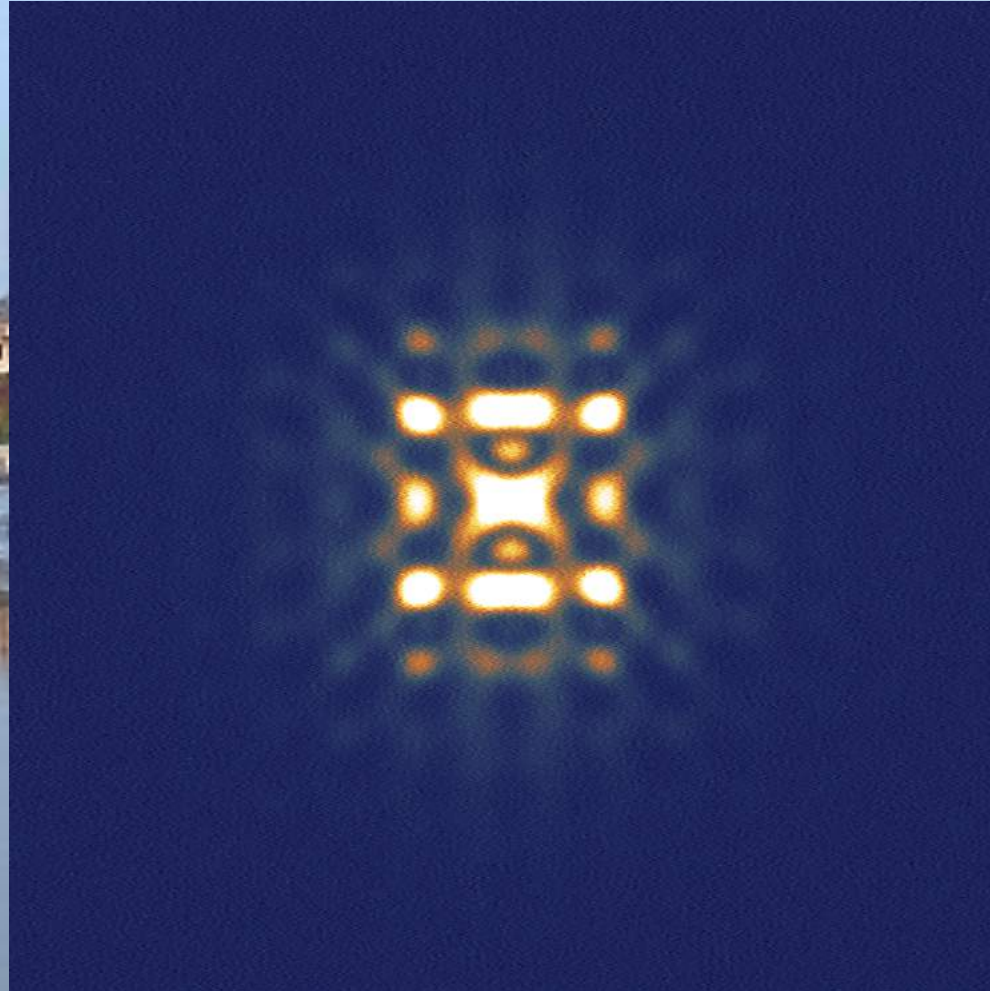


2019 EIPBN MicroGraph Contest

1

Micrograph Title:
Wavefunction of a
Single Arsenic Atom

Description:
Experimental
measurement of the
wavefunction of a
single buried
arsenic dopant atom
peeking through a
hydrogen-
terminated silicon
surface.



Magnification (3"x4" image): 8467KX (12x12 nm)

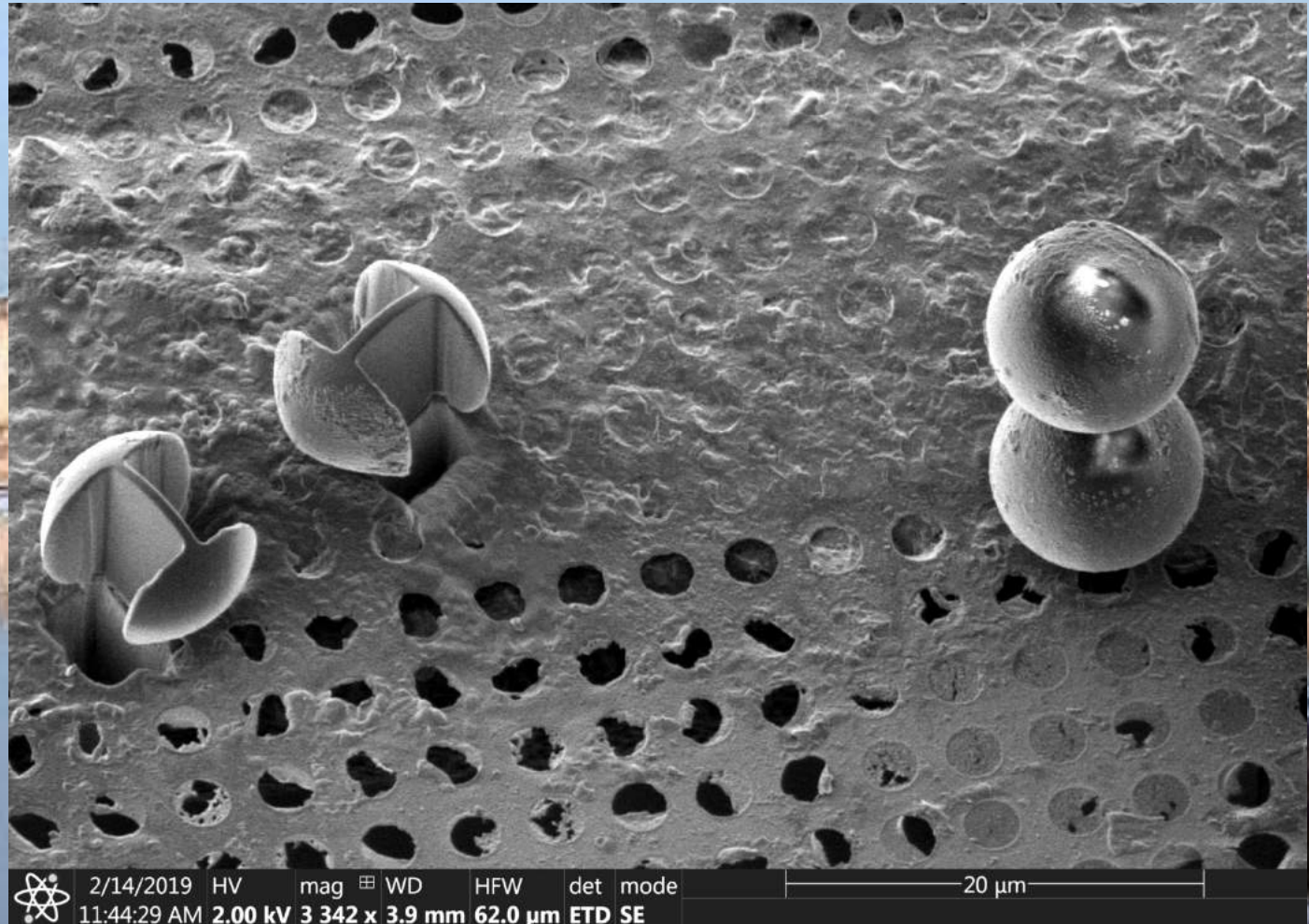
Submitted by: Taleana Huff

Instrument: Omicron LT-SPM

Affiliation: University of Alberta

Micrograph Title:
Imperial TIE fighters
attacking an
innocent Minnesotan
micro-snowman

Description:
Lamellas were ion-
milled in fluores-
cent polystyrene
spheres

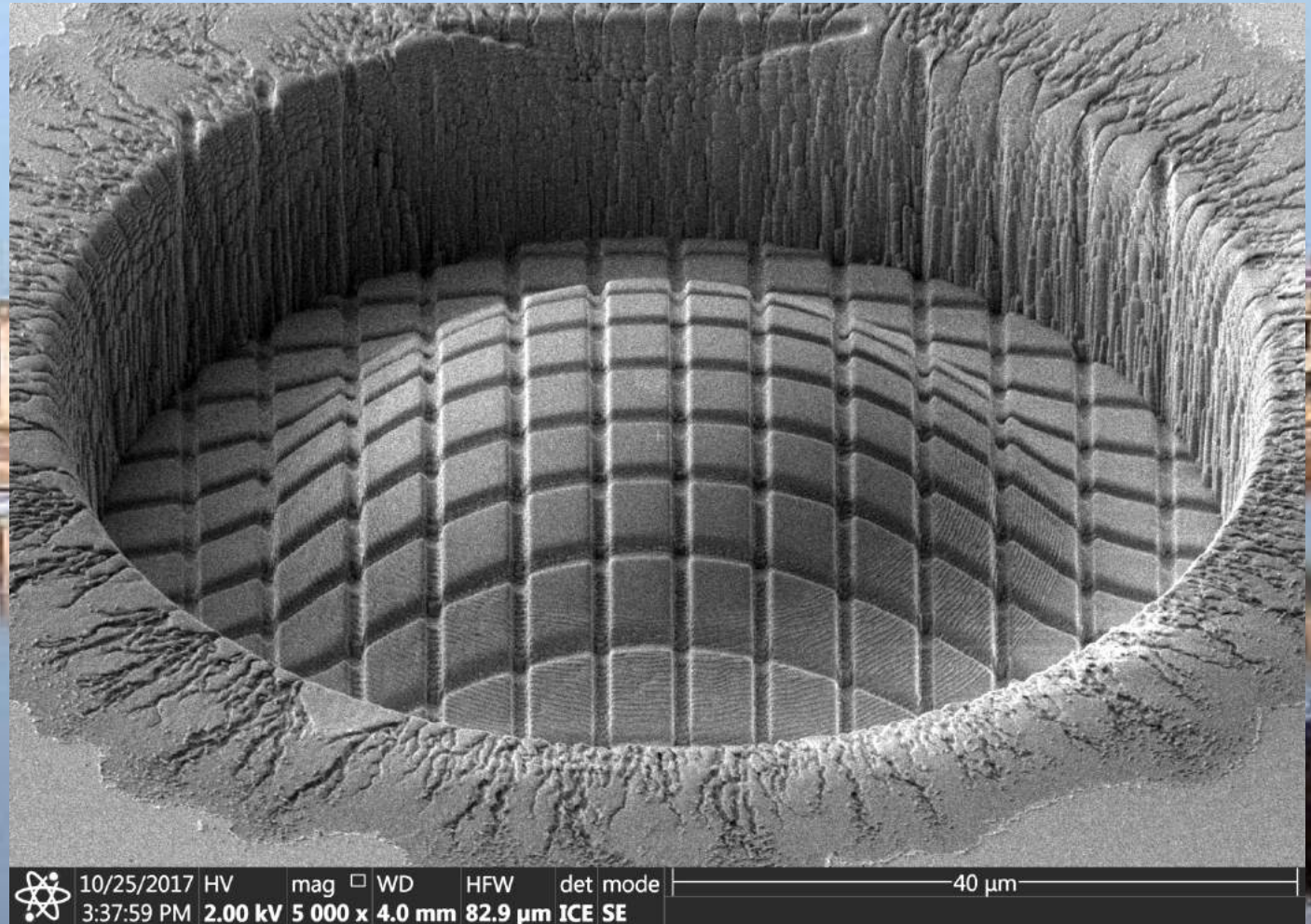


Magnification : 3.3KX (3"x4" image)
Submitted by: Sergey Gorelick

Instrument : ThermoFisher Helios Ux-G4
Affiliation: Monash University, Australia

Micrograph Title:
Micro-Mango

Description:
Microlens milled in
glass with a focused
Xe beam. A 2D
grating was then
etched into its
surface



Magnification : 5KX (3"x4" image)
Submitted by: Sergey Gorelick

Instrument : ThermoFisher Helios Ux-G4
Affiliation: Monash University, Australia

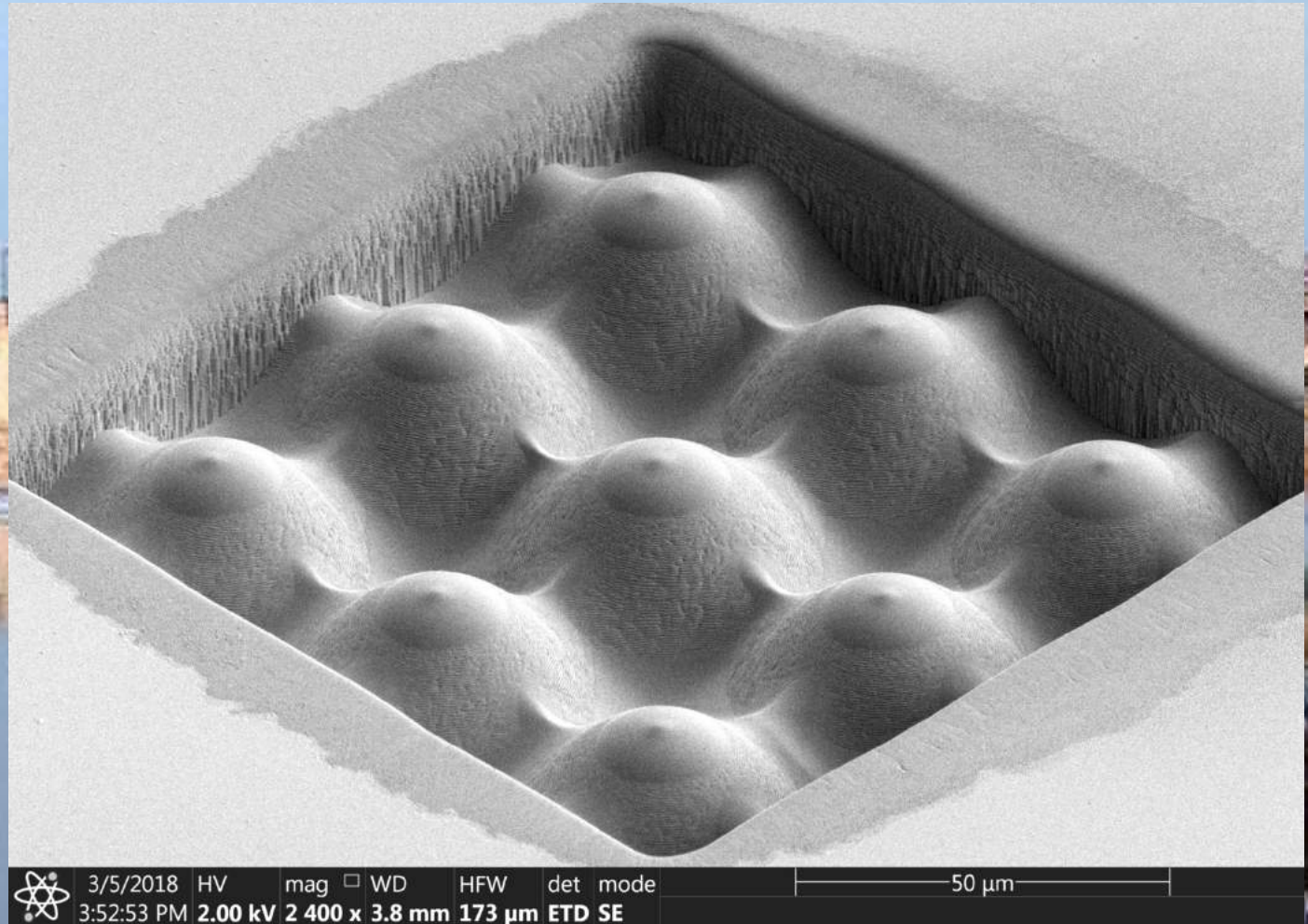


2019 EIPBN MicroGraph Contest

4

Micrograph Title:
Little brother is
watching you

Description:
An array of
microlenses milled
in glass using a
focused Xe beam



3/5/2018 HV mag WD HFW det mode
3:52:53 PM 2.00 kV 2 400 x 3.8 mm 173 μ m ETD SE

50 μ m

Magnification : 2.4KX (3"x4" image)
Submitted by: Sergey Gorelick

Instrument : ThermoFisher Helios Ux-G4
Affiliation: Monash University, Australia

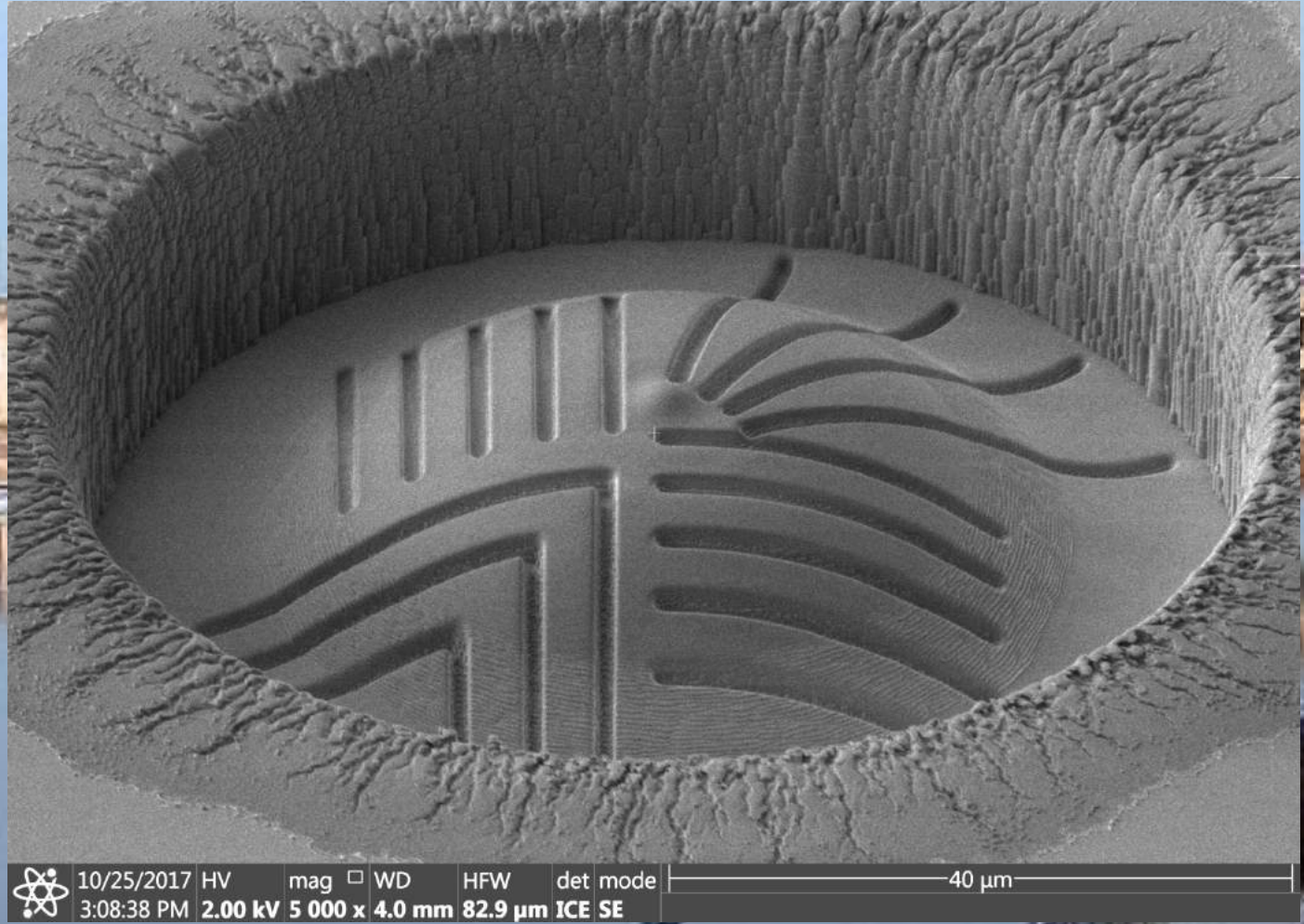



2019 EIPBN MicroGraph Contest

Micrograph Title:
Micro mumbo jumbo



Description:
Microlens milled in glass with a focused Xe beam. Surface features were then etched into its surface



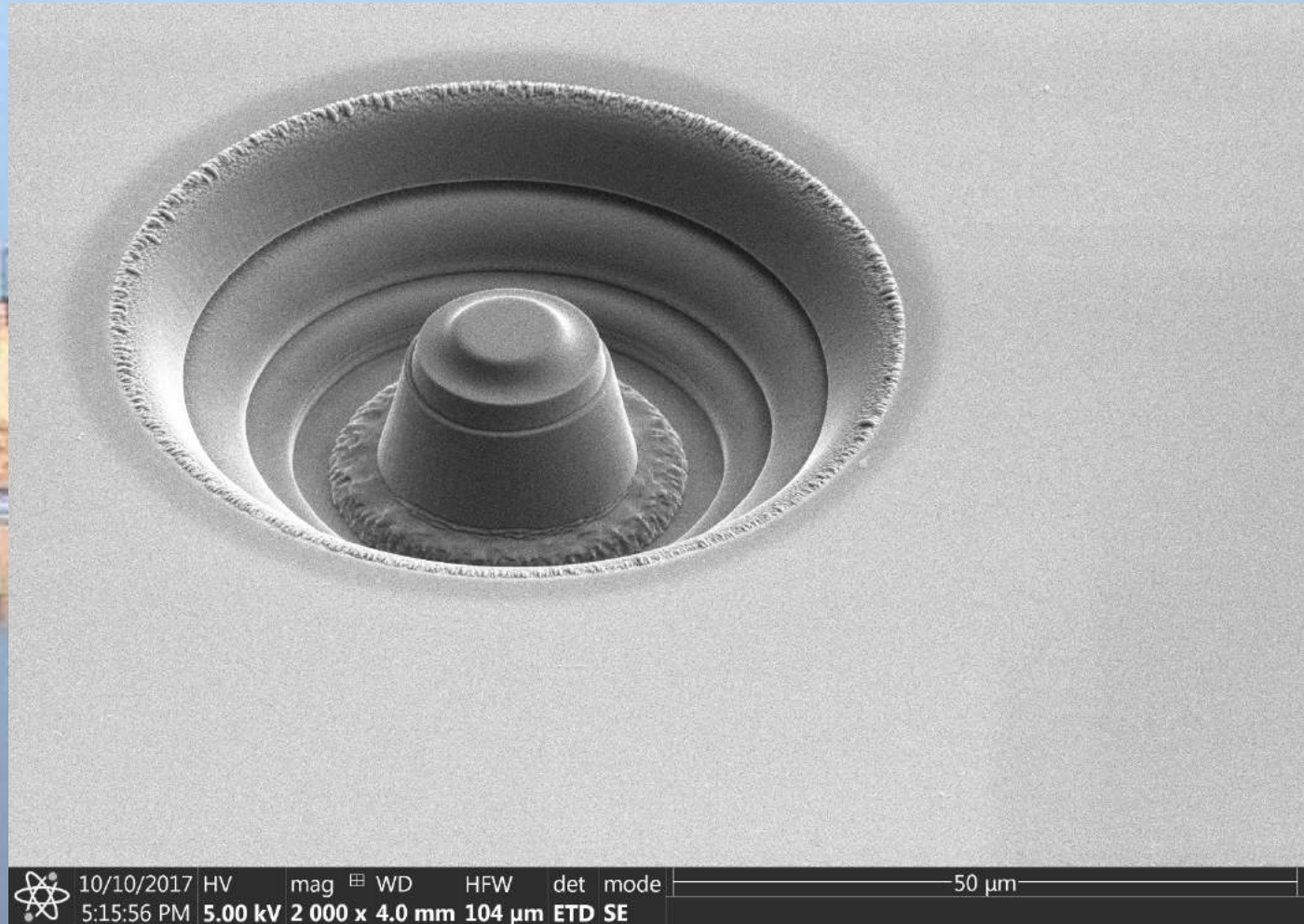
	10/25/2017 HV	mag	WD	HFWD	det	mode	40 μ m
	3:08:38 PM	2.00 kV	5 000 x	4.0 mm	82.9 μ m	ICE SE	

Magnification : 5KX (3"x4" image)
Submitted by: Sergey Gorelick

Instrument : ThermoFisher Helios Ux-G4
Affiliation: Monash University, Australia

Micrograph Title:
A delicious silicon
blueberry micro-
muffin

Description:
Concentric rings
with variable depth
were milled in Si
using a focused Xe
beam



Magnification : 5KX (3"x4" image)
Submitted by: Sergey Gorelick

Instrument : ThermoFisher Helios Ux-G4
Affiliation: Monash University, Australia

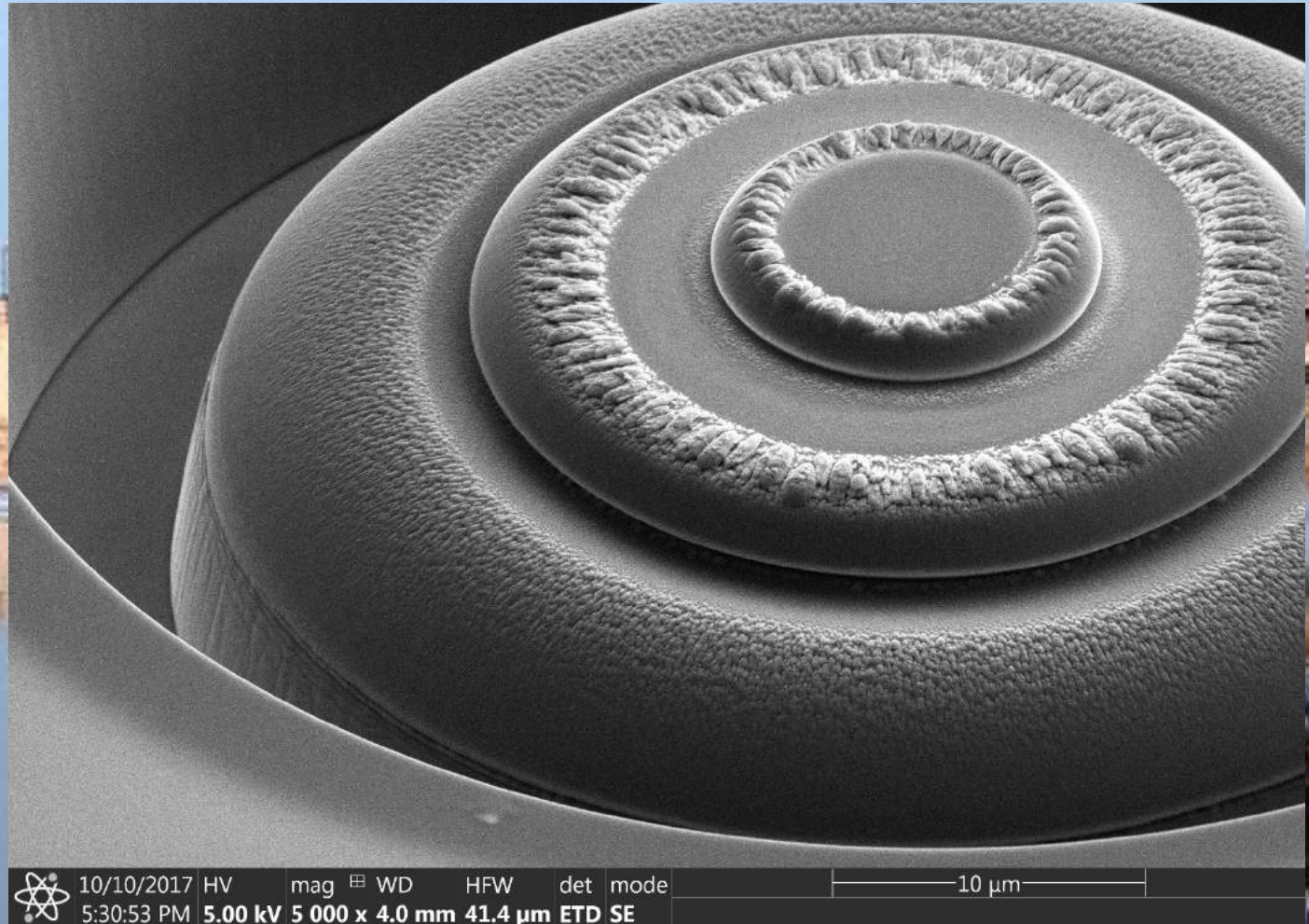


2019 EIPBN MicroGraph Contest

7

Micrograph Title:
A delicious
chocolate Si layered
micro-cake with
extra topping

Description:
Concentric rings
with variable depth
were milled in Si
using a focused Xe
beam



Magnification : 5KX (3"x4" image)
Submitted by: Sergey Gorelick

Instrument : ThermoFisher Helios Ux-G4
Affiliation: Monash University, Australia

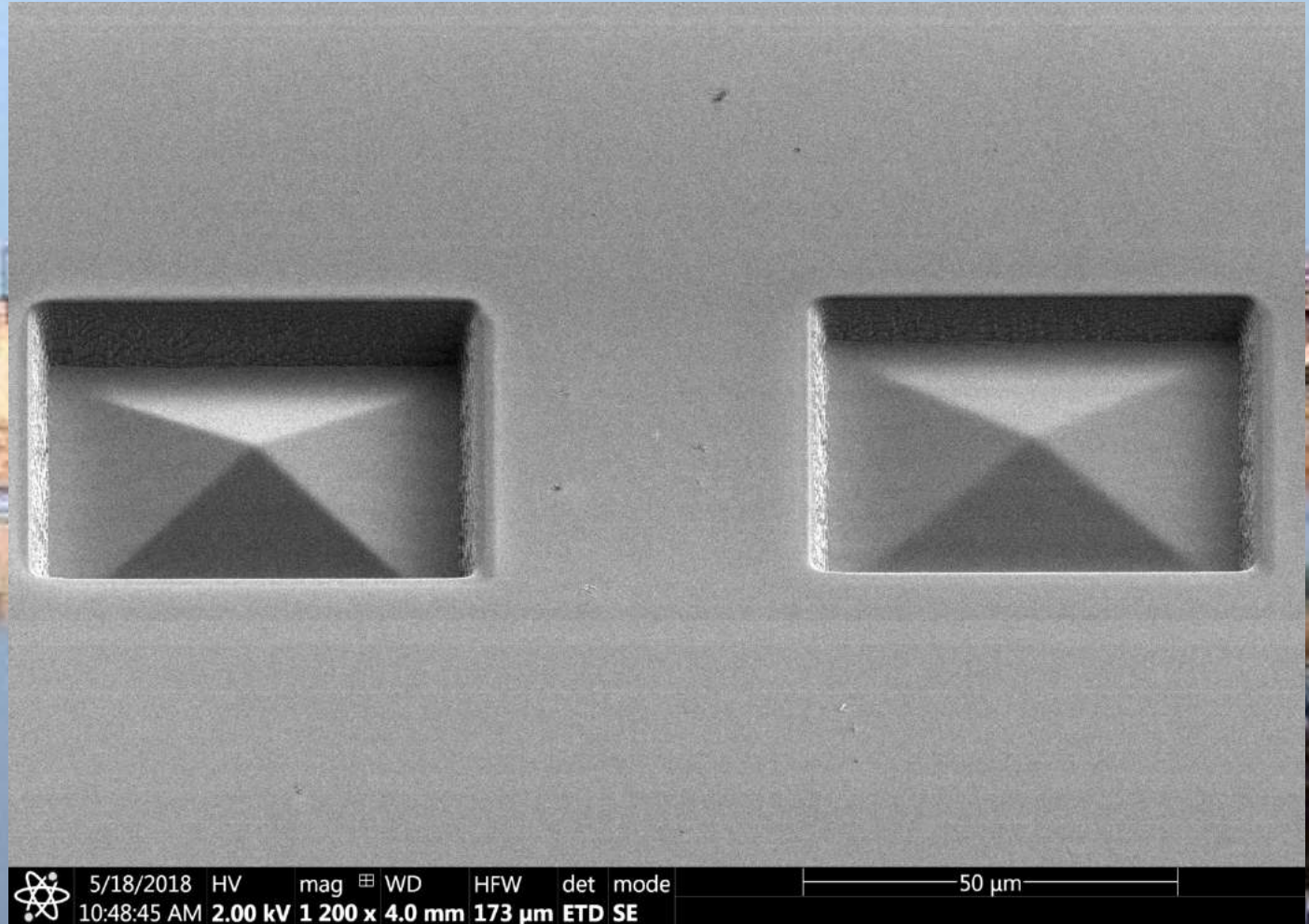


2019 EIPBN MicroGraph Contest

8

Micrograph Title:
Beware of the micro-mummies!

Description:
Pyramids were milled in lithium niobate crystal using a focused Xe beam



5/18/2018 HV mag \boxplus WD HFW det mode
10:48:45 AM 2.00 kV 1 200 x 4.0 mm 173 μ m ETD SE

Magnification : 1.2KX (3"x4" image)
Submitted by: Sergey Gorelick

Instrument : ThermoFisher Helios Ux-G4
Affiliation: Monash University, Australia

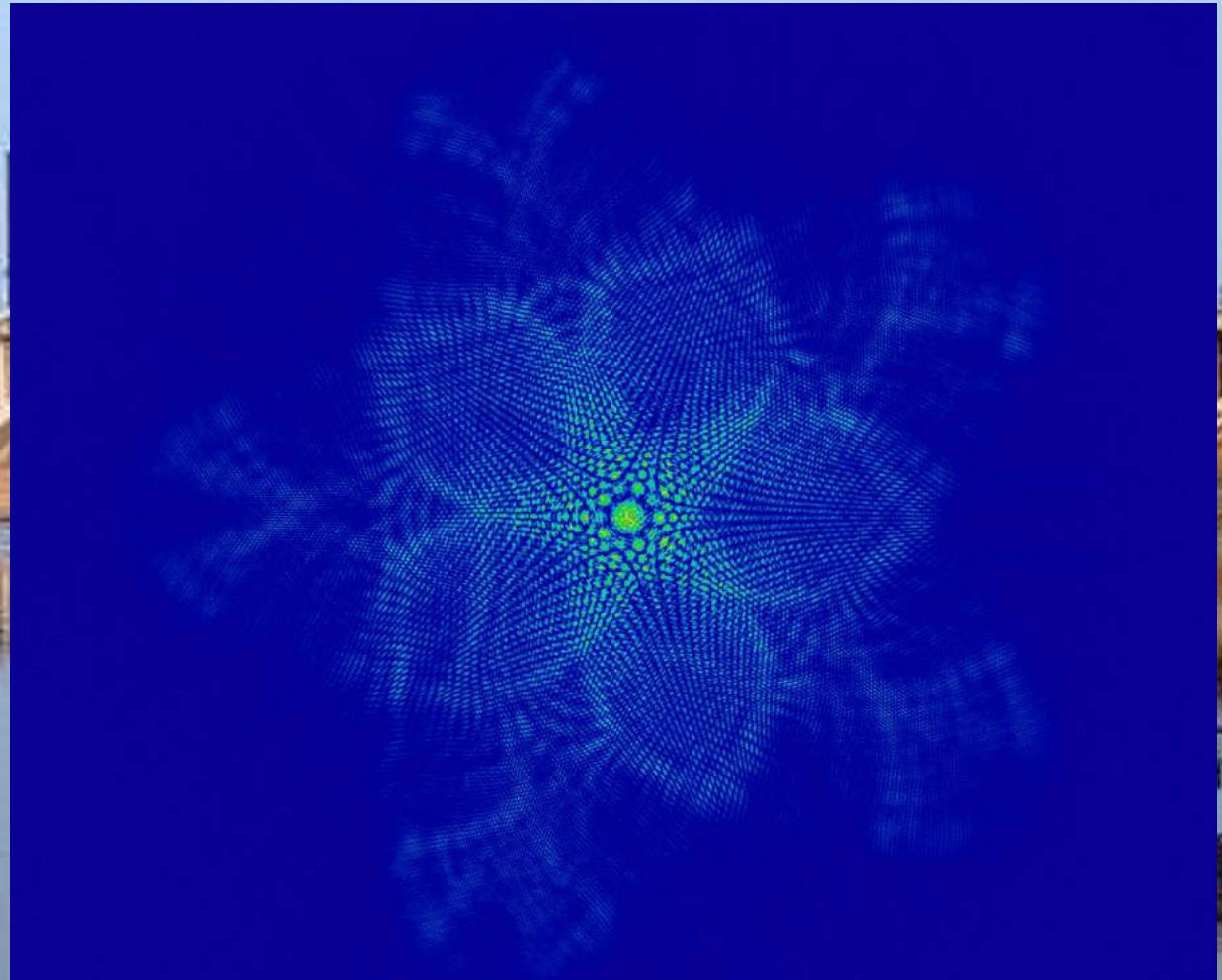


2019 EIPBN MicroGraph Contest

9

Micrograph Title:
Photonic snowflake

Description:
Far-field intensity
produced by a
diffractive optical
element



Magnification : 40 (3"x4" image)
Submitted by: Sergey Gorelick

Instrument : Andor Zyla 4.2 cMOS
Affiliation: Monash University, Australia

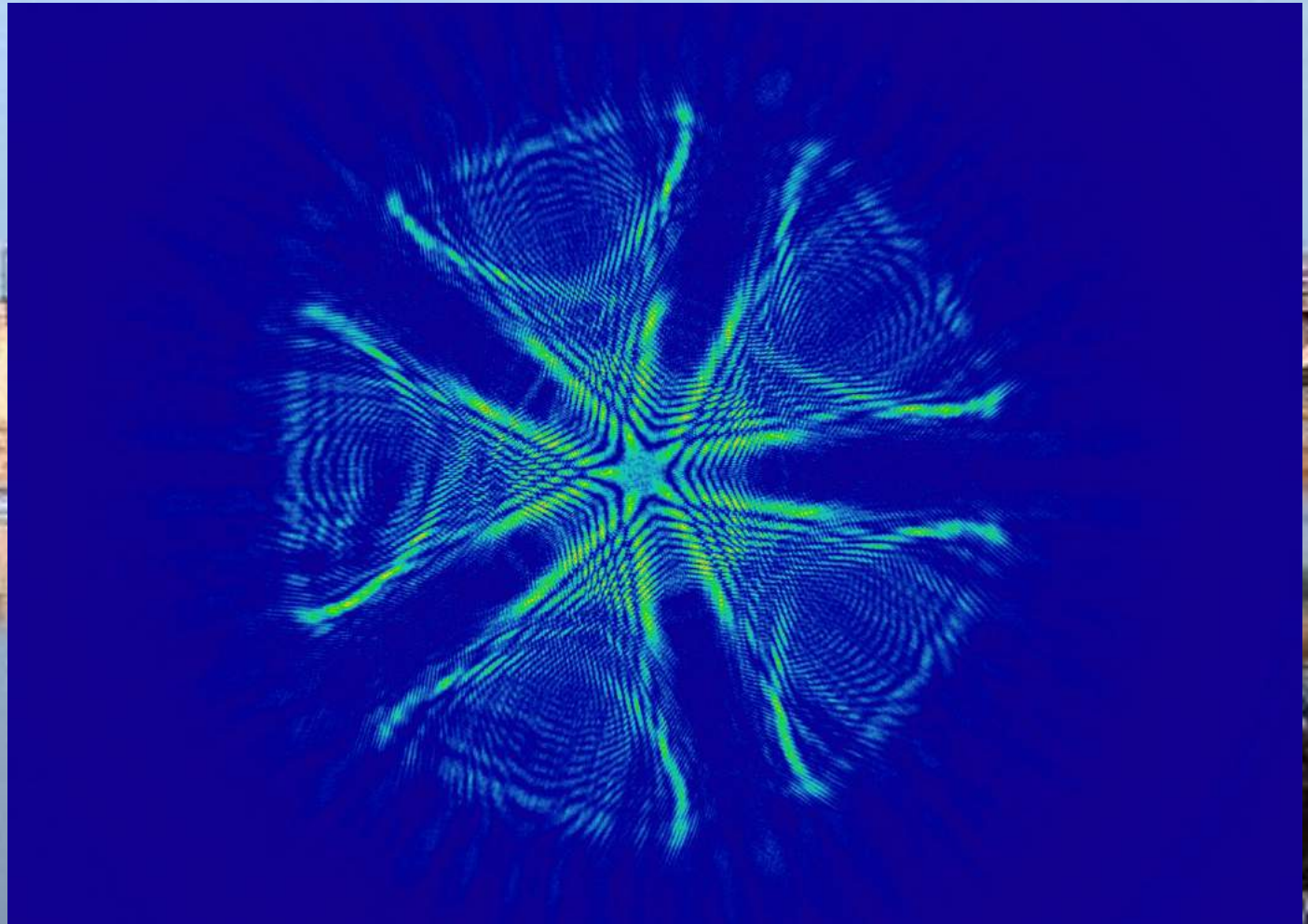


2019 EIPBN MicroGraph Contest

10

Micrograph Title:
Photonic snowflake2

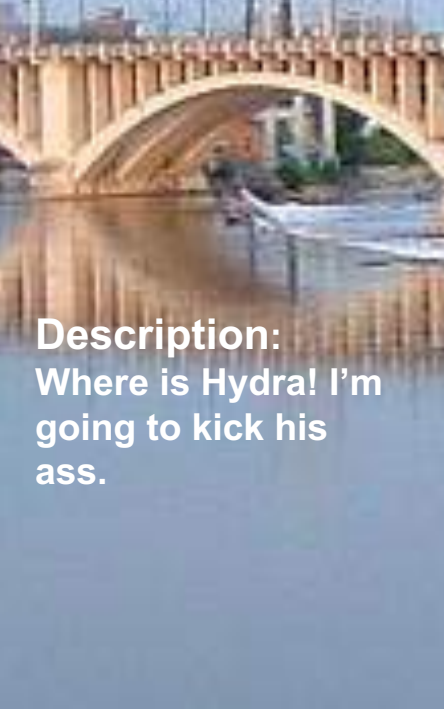
Description:
Near-field intensity
produced by a
diffractive optical
element



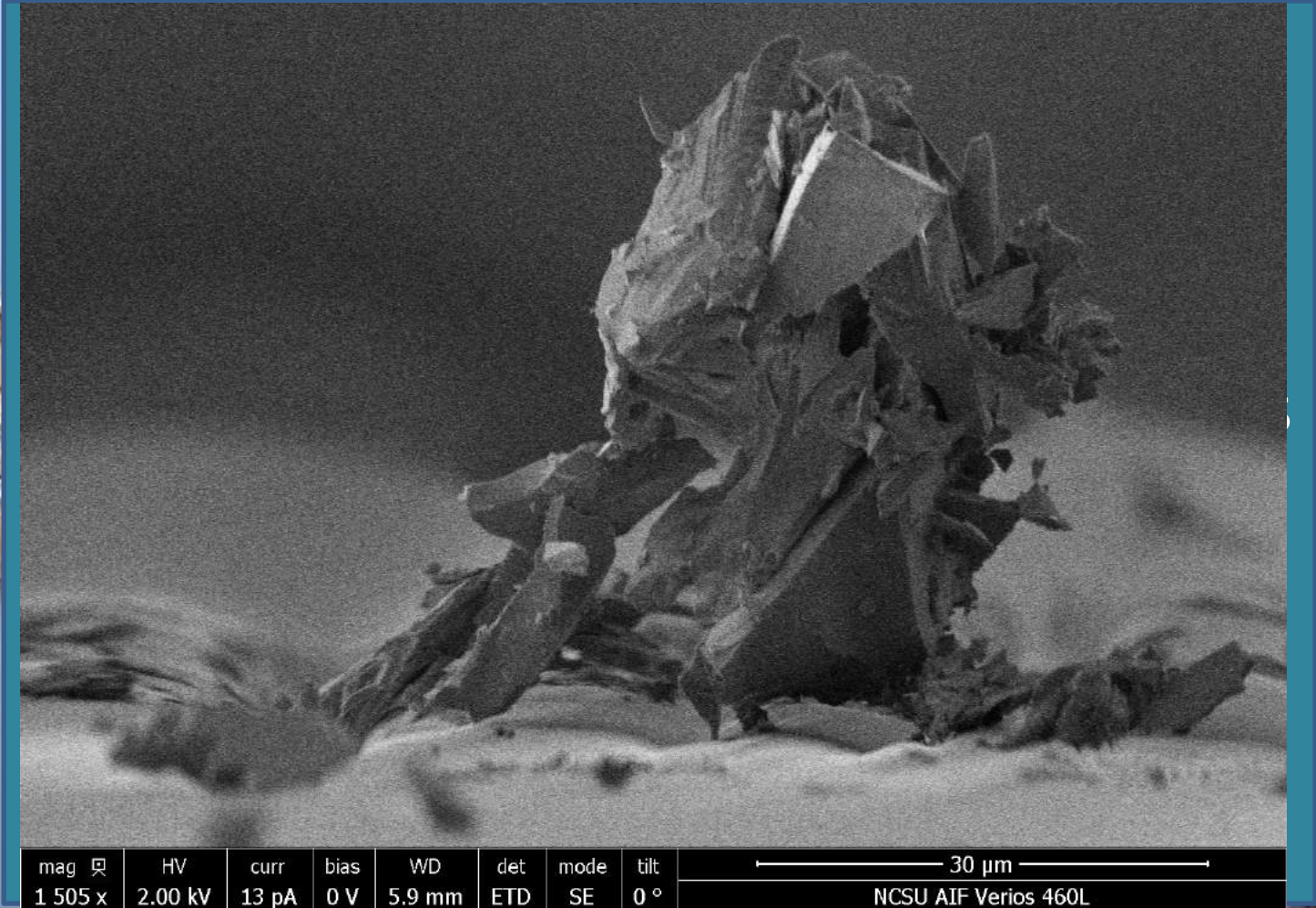
Magnification : 40 (3"x4" image)
Submitted by: Sergey Gorelick

Instrument : Andor Zyla 4.2 cMOS
Affiliation: Monash University, Australia

Micrograph Title:
 Godzilla



Description:
 Where is Hydra! I'm going to kick his ass.



mag	HV	curr	bias	WD	det	mode	tilt	30 μm	
1 505 x	2.00 kV	13 pA	0 V	5.9 mm	ETD	SE	0 °	NCSU AIF Verios 460L	

Magnification (3"x4" image): 1.5KX
Submitted by: Yi-An Chen
University

Instrument : FEI Verios 460L
Affiliation: North Carolina State

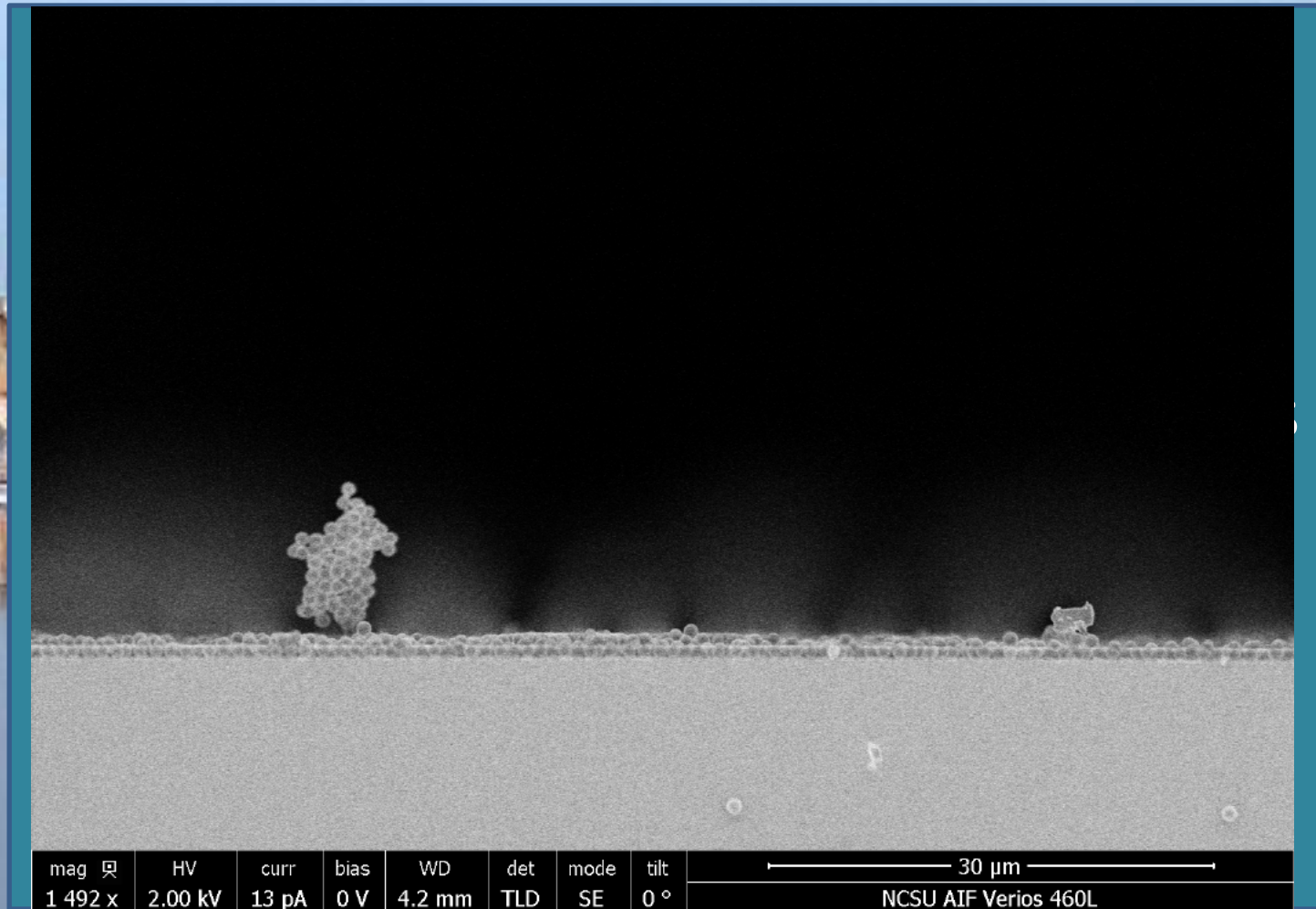


2019 EIPBN MicroGraph Contest

12

Micrograph Title:
Come on, puppy
let's go home

Description:
When you lose
control of your
puppy...



Magnification (3"x4" image): 1.5KX
Submitted by: Yi-An Chen
University

Instrument : FEI Verios 460L
Affiliation: North Carolina State

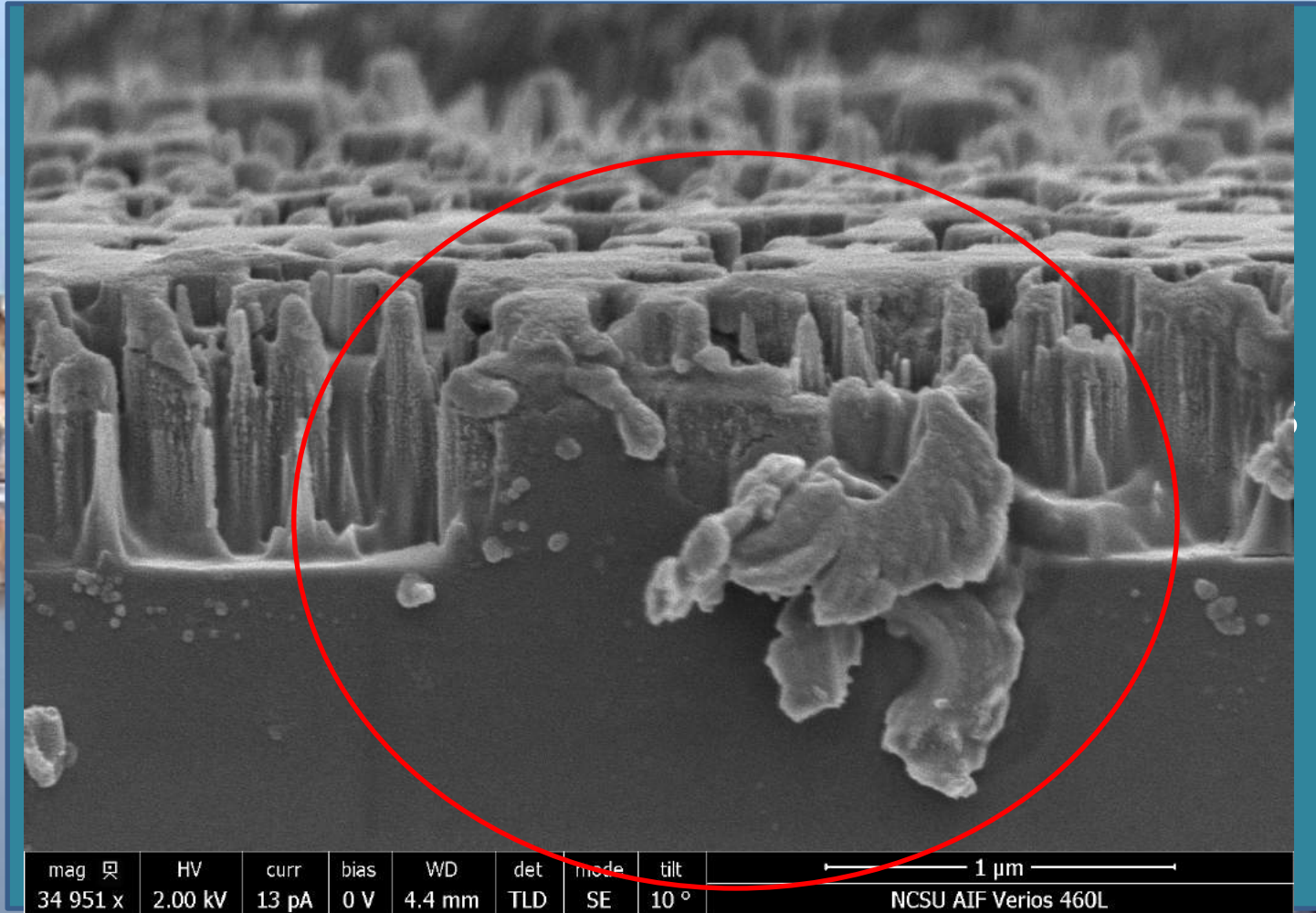


2019 EIPBN MicroGraph Contest

13

Micrograph Title:
Walrus say hi

Description:
10 dollar per person,
accept beer



Magnification (3"x4" image): 2KX

Instrument: FEI Verios 460L

Submitted by: Yi-An Chen

Affiliation: North Carolina State

University

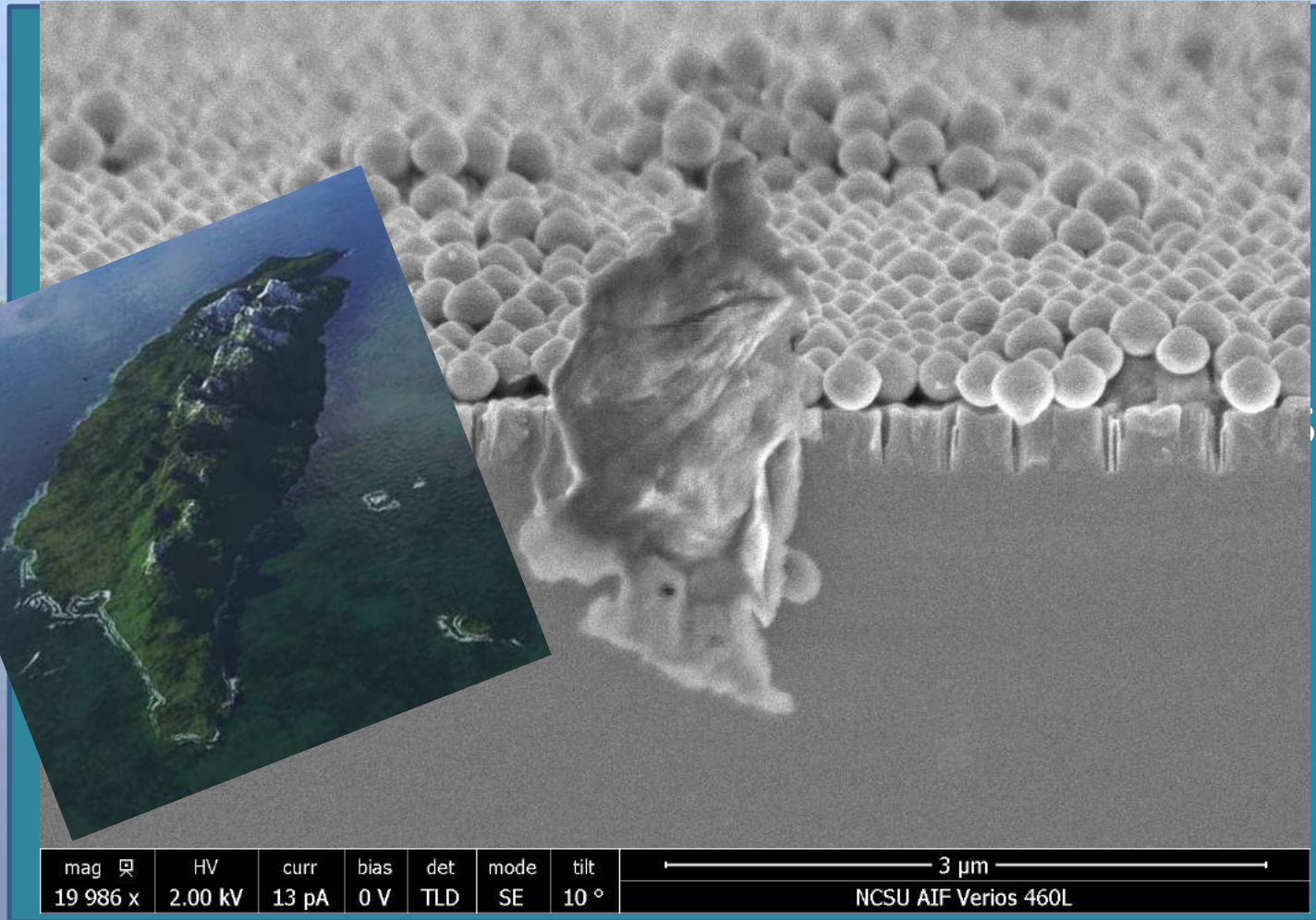


2019 EIPBN MicroGraph Contest

14

Micrograph Title:
Formosa Taiwan

Description:
My island is like a leaf at the edge of Pacific ocean.



Magnification (3"x4" image): 2KX
Submitted by: Yi-An Chen
University

Instrument : FEI Verios 460L
Affiliation: North Carolina State

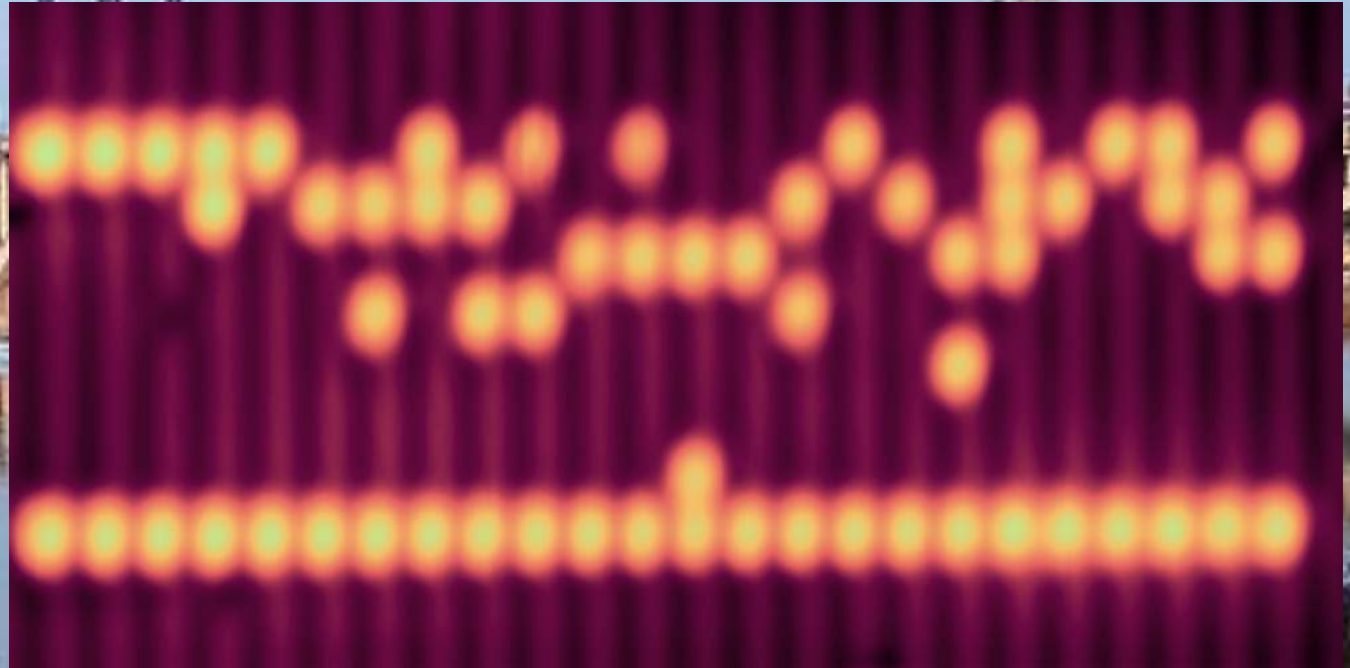


2019 EIPBN MicroGraph Contest

15

Micrograph Title:
Mini Mario (DO DO
DO DaDo DO)

Description:
24 notes of the Super Mario theme song converted to binary and stored in silicon dangling bonds at a density of 1.1 petabits per square inch



Magnification: 21.5 nm x 10.7 nm
Submitted by: Roshan Achal

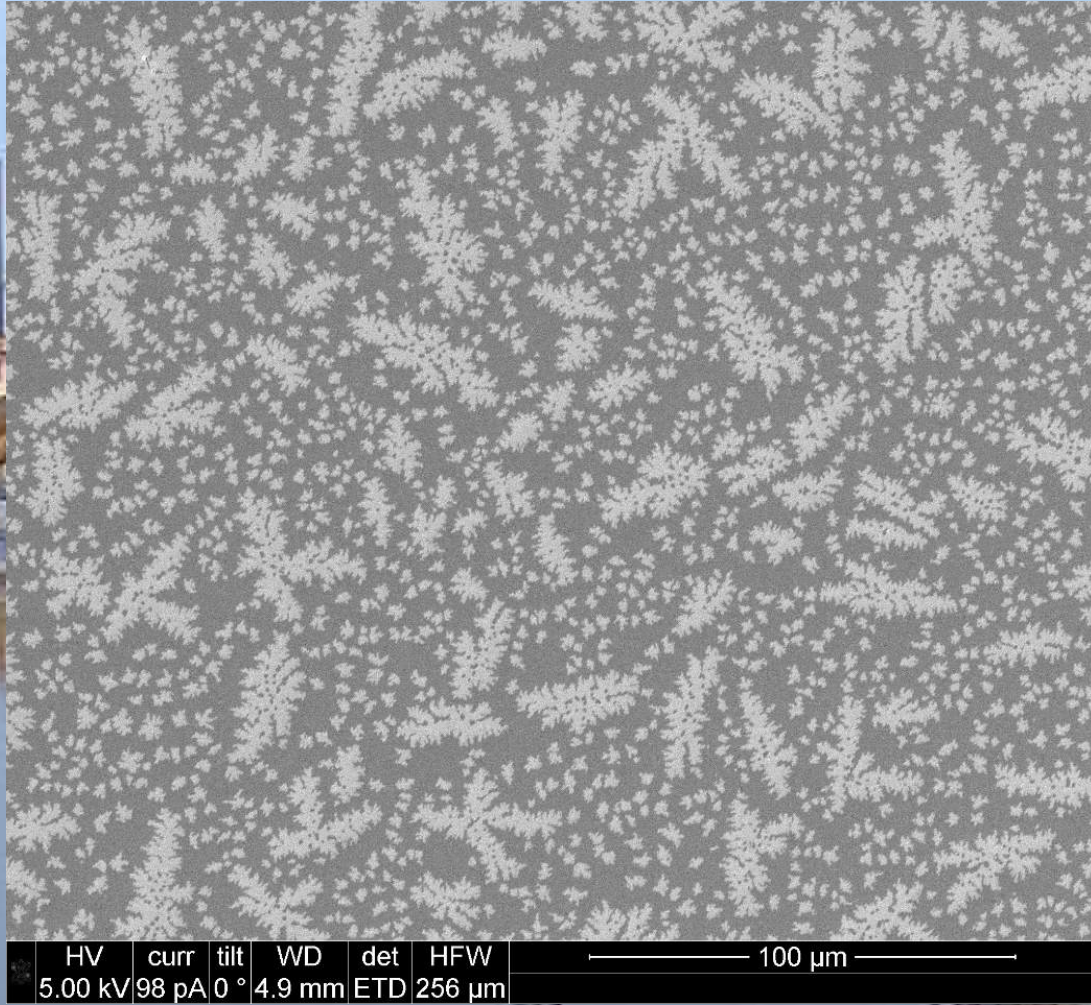
Instrument: Omicron LT STM
Affiliation: University of Alberta



2019 EIPBN MicroGraph Contest

Micrograph Title:
The beauty of autumn leaves

Description:
When you leave a gold coated Si wafer in a IKEA box.



HV	curr	tilt	WD	det	HFW	100 μ m	
5.00 kV	98 pA	0 °	4.9 mm	ETD	256 μ m		

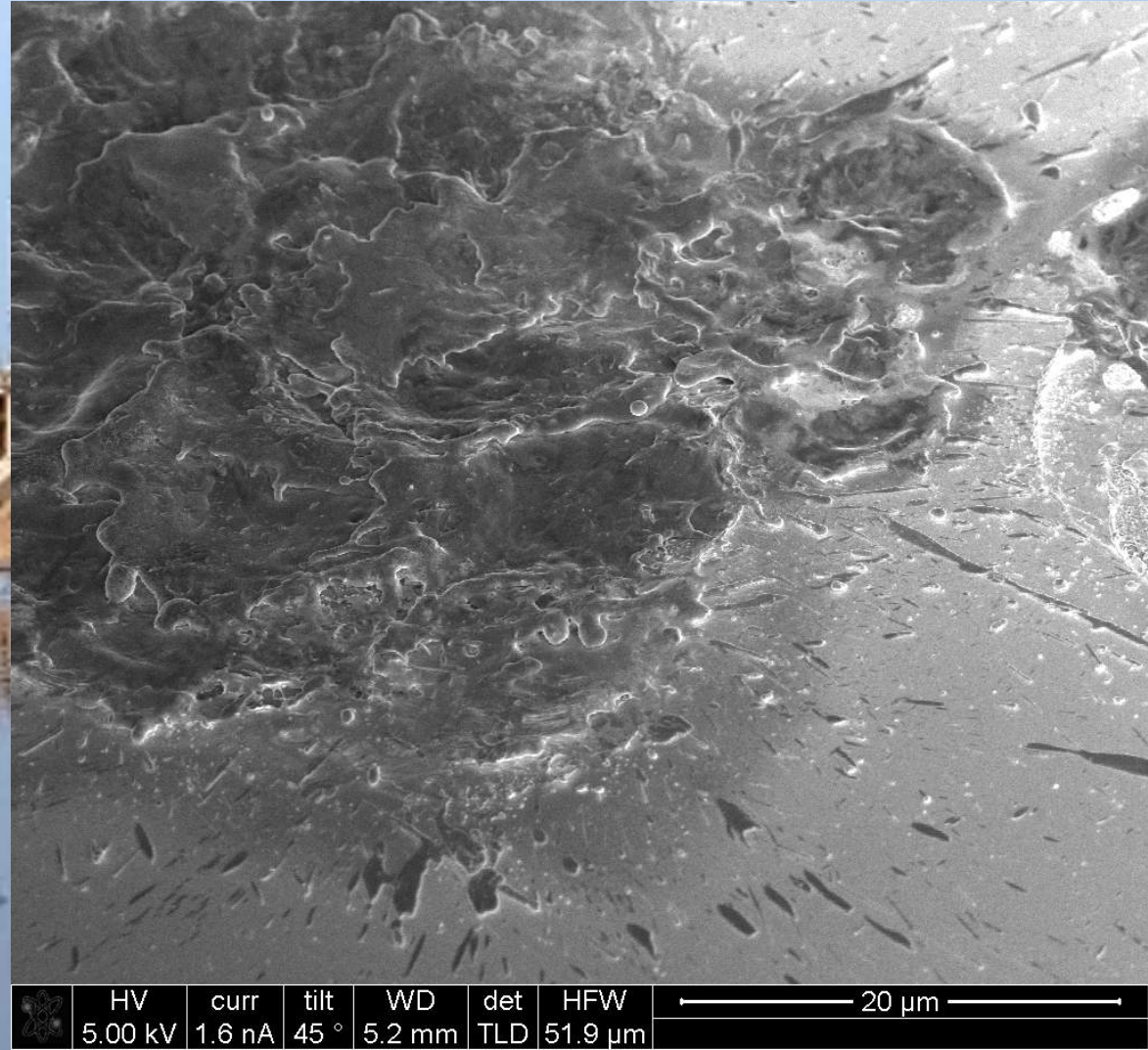
Magnification (3"x4" image): 300X **Instrument : Nova Nanolab 650 SEM**
Submitted by: Gaudhaman Jeevanandam **Affiliation: TU Delft, The Netherlands**



2019 EIPBN MicroGraph Contest

Micrograph Title:
A stormy day at the bay.

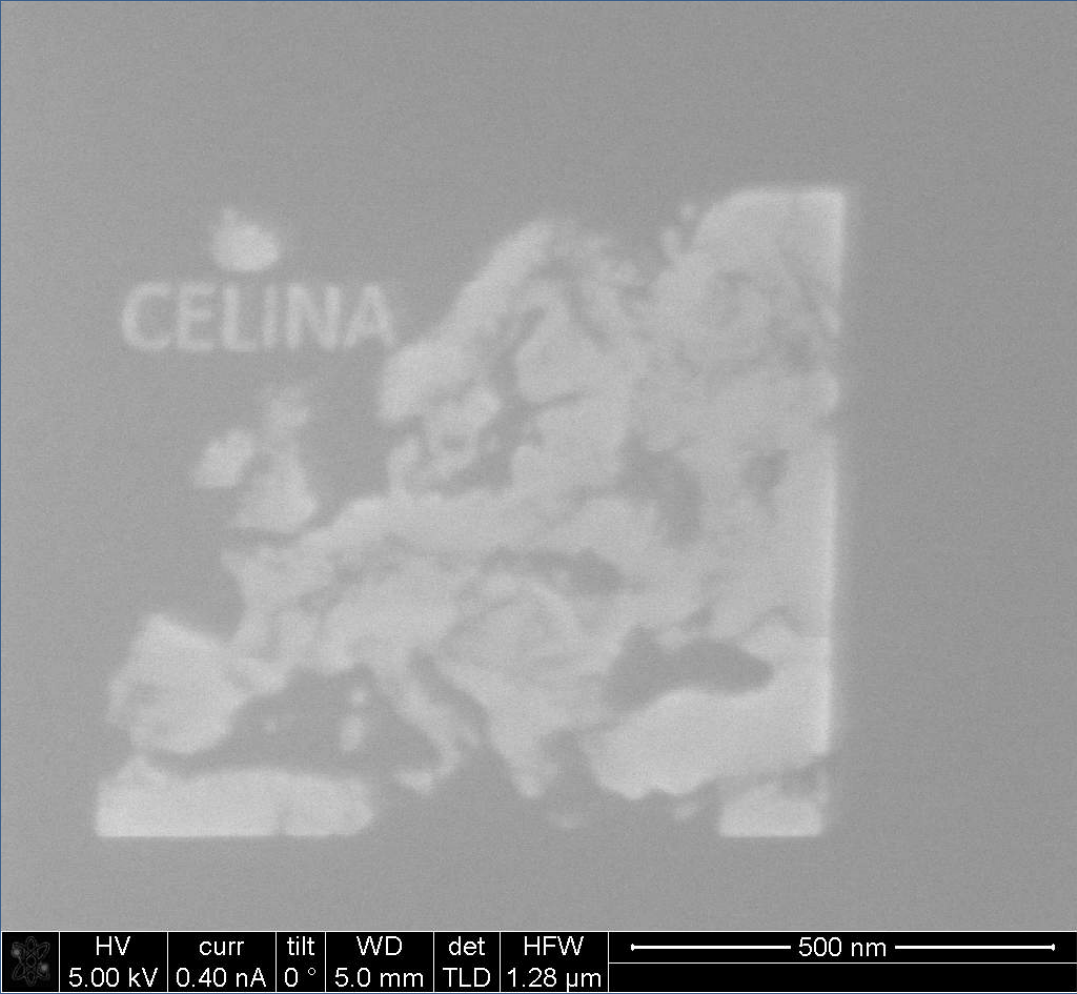
Description:
Results of arcing from a microplasma source on an Au film.



Magnification (3"x4" image): 2KX Instrument : Nova Nanolab 650 SEM
Submitted by: Gaudhaman Jeevanandam Affiliation: TU Delft, The Netherlands

Micrograph Title:
 Europe in a
 nutshell, no in a
 nanoshell!

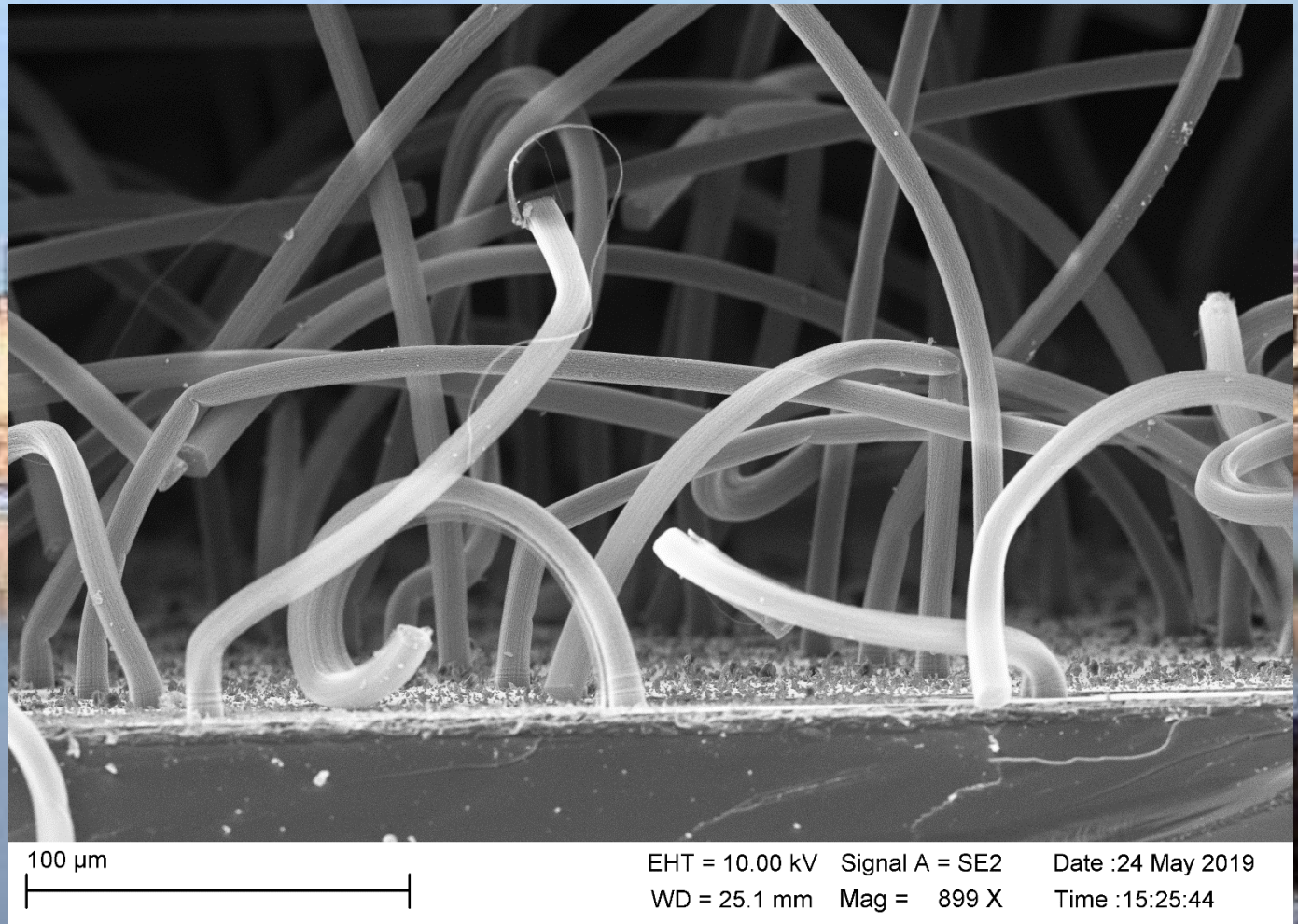
Description:
 Europe map
 patterned using
 Electron beam
 induced deposition of
 Platinum. This is in
 3D, the heights differ
 according to
 altitudes!



Magnification (3"x4" image): 100KX Instrument : Nova Nanolab 650 SEM
Submitted by: Gaudhaman Jeevanandam Affiliation: TU Delft, The Netherlands

Micrograph Title:
Conference meeting
of the car dealership
inflatable tube men.

Description:
Array of 10 μm
square pillars of
multi-wall carbon
nanotubes made by
patterning array of
iron catalyst islands
on Si wafer.

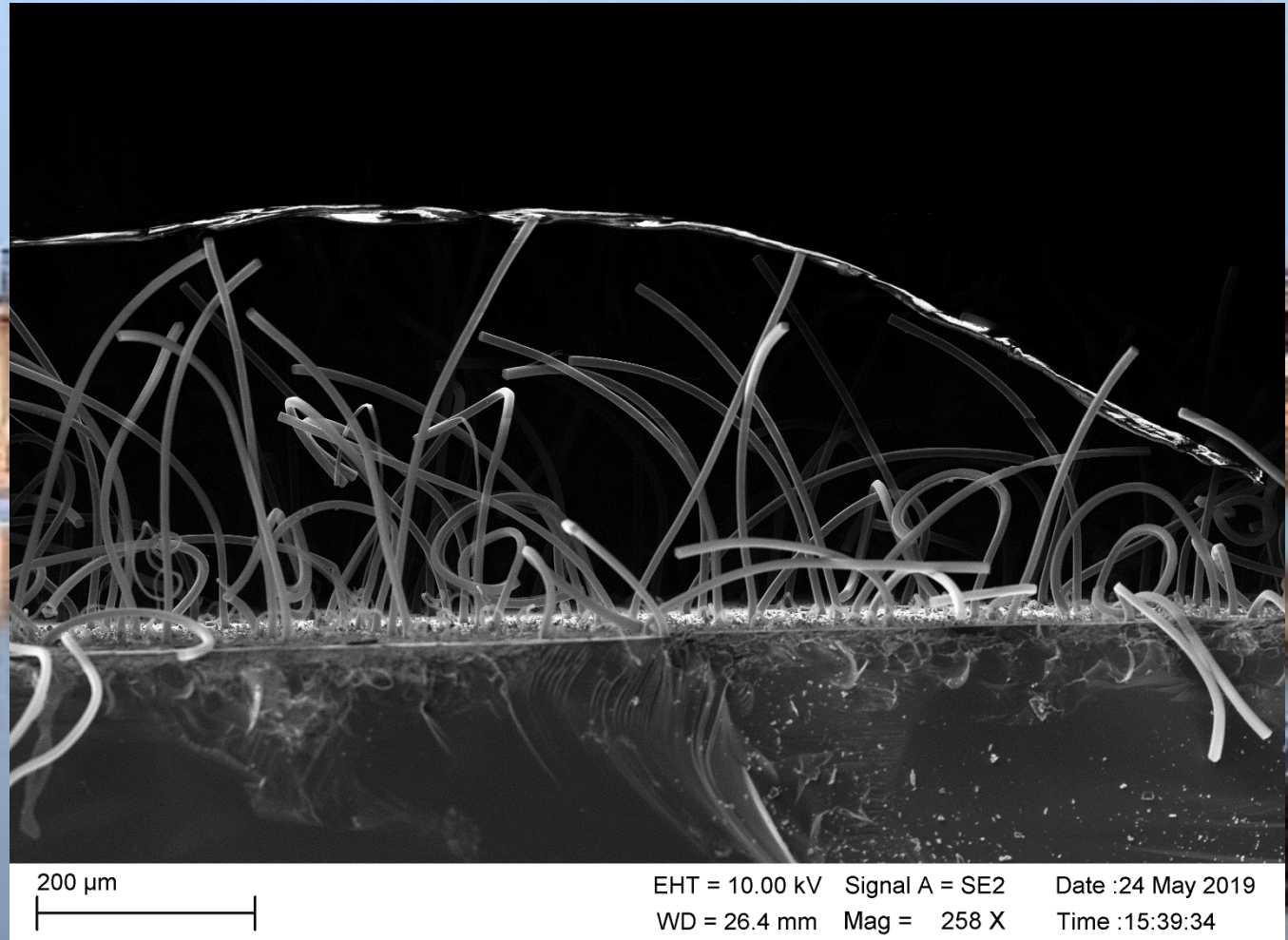


Magnification (3"x4" image): 899X
Submitted by: Casimir Kuzyk

Instrument : Zeiss Sigma SEM
Affiliation: University of British Columbia

Micrograph Title:
Cousin Itt takes a
Micrograph

Description:
Array of 10 μm
square pillars of
multi-wall carbon
nanotubes. Made by
patterning iron
catalyst islands on
Si wafer. +
somebodies hair



Magnification (3"x4" image): 258X
Submitted by: Casimir Kuzyk

Instrument : Zeiss Sigma SEM
Affiliation: University of British Columbia

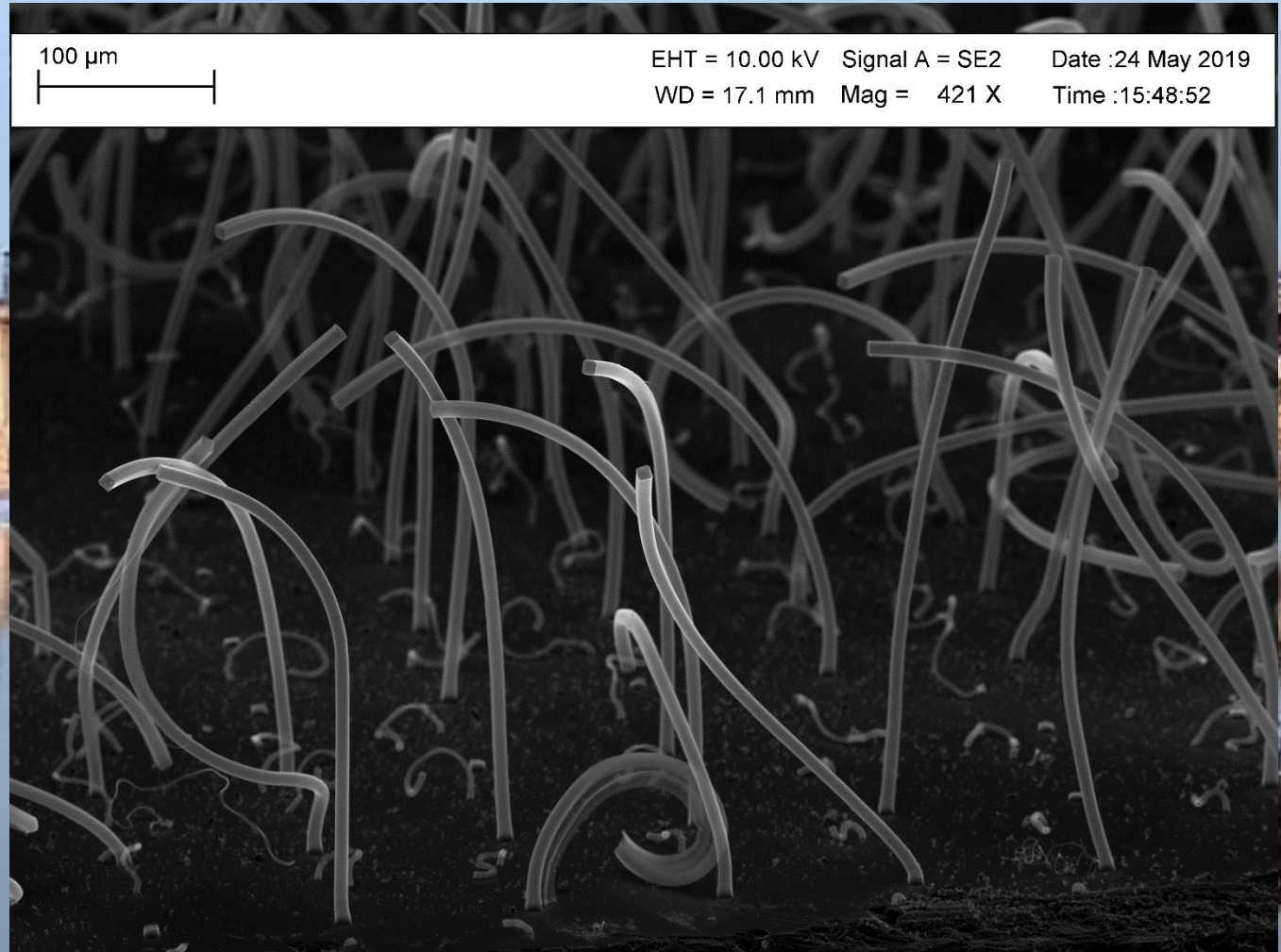


2019 EIPBN MicroGraph Contest

21

Micrograph Title:
Hair of the dog

Description:
Array of 10 μm square pillars of multi-wall carbon nanotubes. Made by patterning iron catalyst islands on Si wafer.



Magnification (3"x4" image): 421X
Submitted by: Casimir Kuzyk

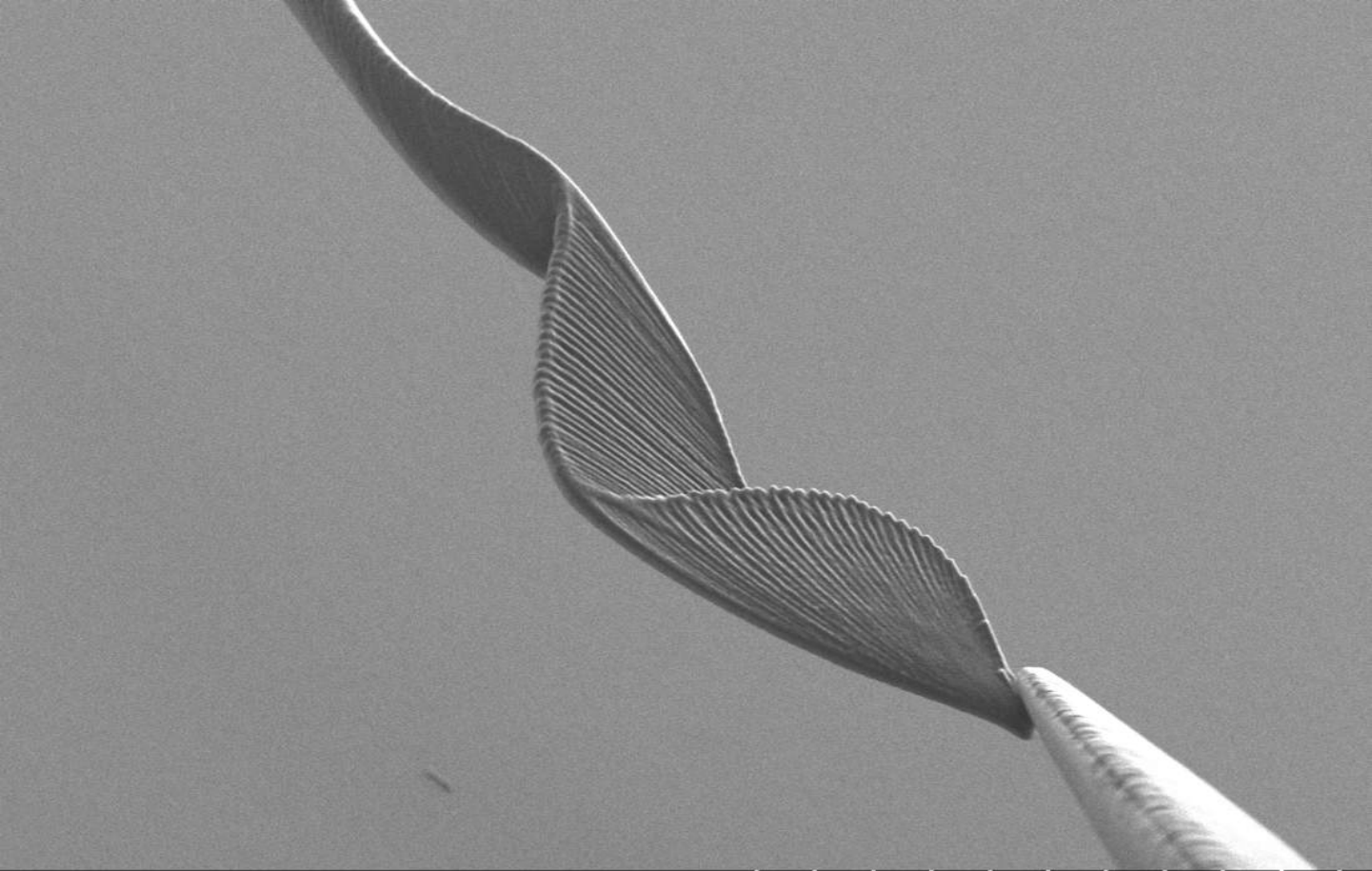
Instrument : Zeiss Sigma SEM
Affiliation: University of British Columbia



2019 EIPBN MicroGraph Contest

Micrograph Title:
Magic Sound with
Wind

Description:
Unknown vibration
disturbed the
waveguide writing
by Nanoscribe 3D,
and was recorded in
the resist.



DRIE 6x30s 1.0kV 8.7mm x1.80k SE(L) 30.0µm

Magnification (3"x4" image): 1.8KX
Submitted by: Jiangdong Deng (JD)

Instrument : Hitachi 8230 SEM
Affiliation: CNS at Harvard University

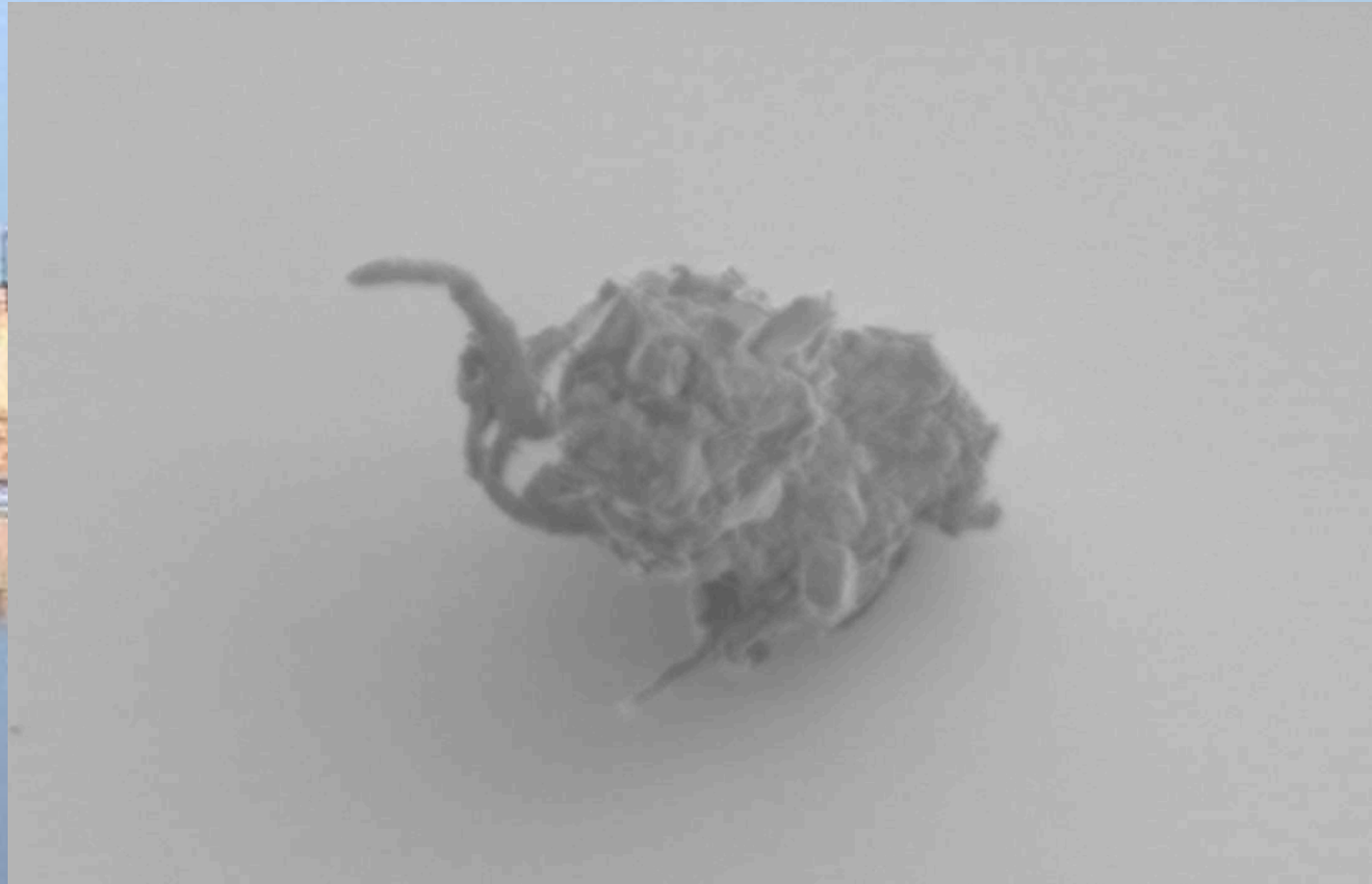


2019 EIPBN MicroGraph Contest

23

Micrograph Title:
Ostrich wandering
under the electron
beam

Description:
Polymer particle
under SEM



2.0kV 10.5mm x2.00k LM(UL) 07/09/2018

20.0µm

Magnification (3"x4" image): 2.0 KX
Submitted by: Jiangdong Deng (JD)

Instrument : Hitachi 8230 SEM
Affiliation: CNS at Harvard University



2019 EIPBN MicroGraph Contest

24

Micrograph Title:
Nano-dancing Team

Description:
Tilted nano pillars by
3D Nanoscribe
printer



Magnification (3"x4" image): 2.5 KX
Submitted by: Jiangdong Deng (JD)

Instrument : Hitachi 8230 SEM
Affiliation: CNS at Harvard University



2019 EIPBN MicroGraph Contest

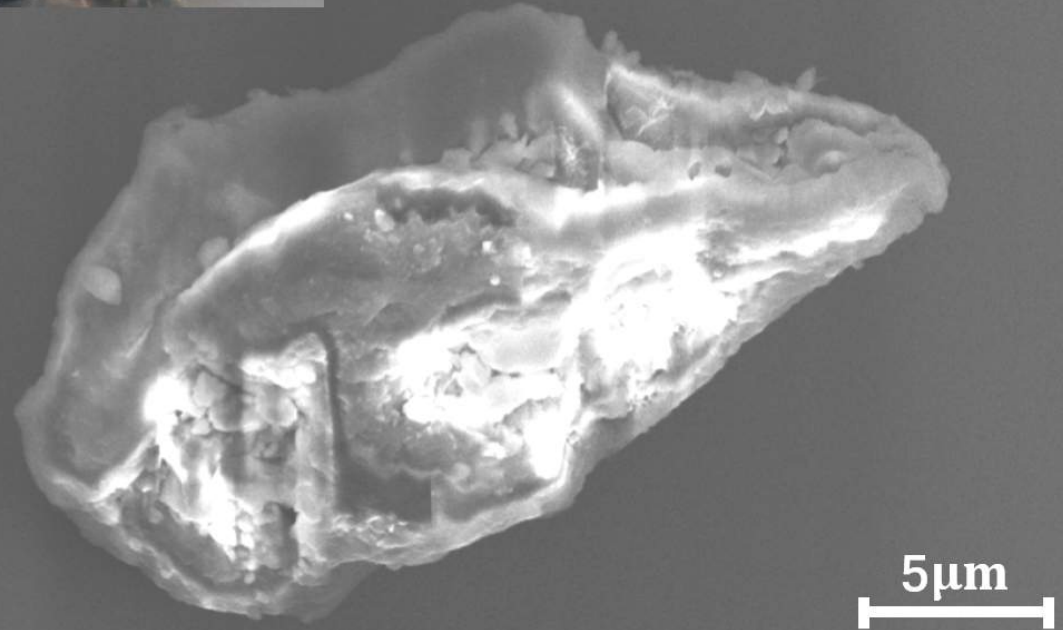
25

Micrograph Title:
Micro-Oyster

Real Oyster



Description:
I am the cutest oyster
in this world!



Magnification (3"x4" image): 2.3KX
Submitted by: Hao Yang

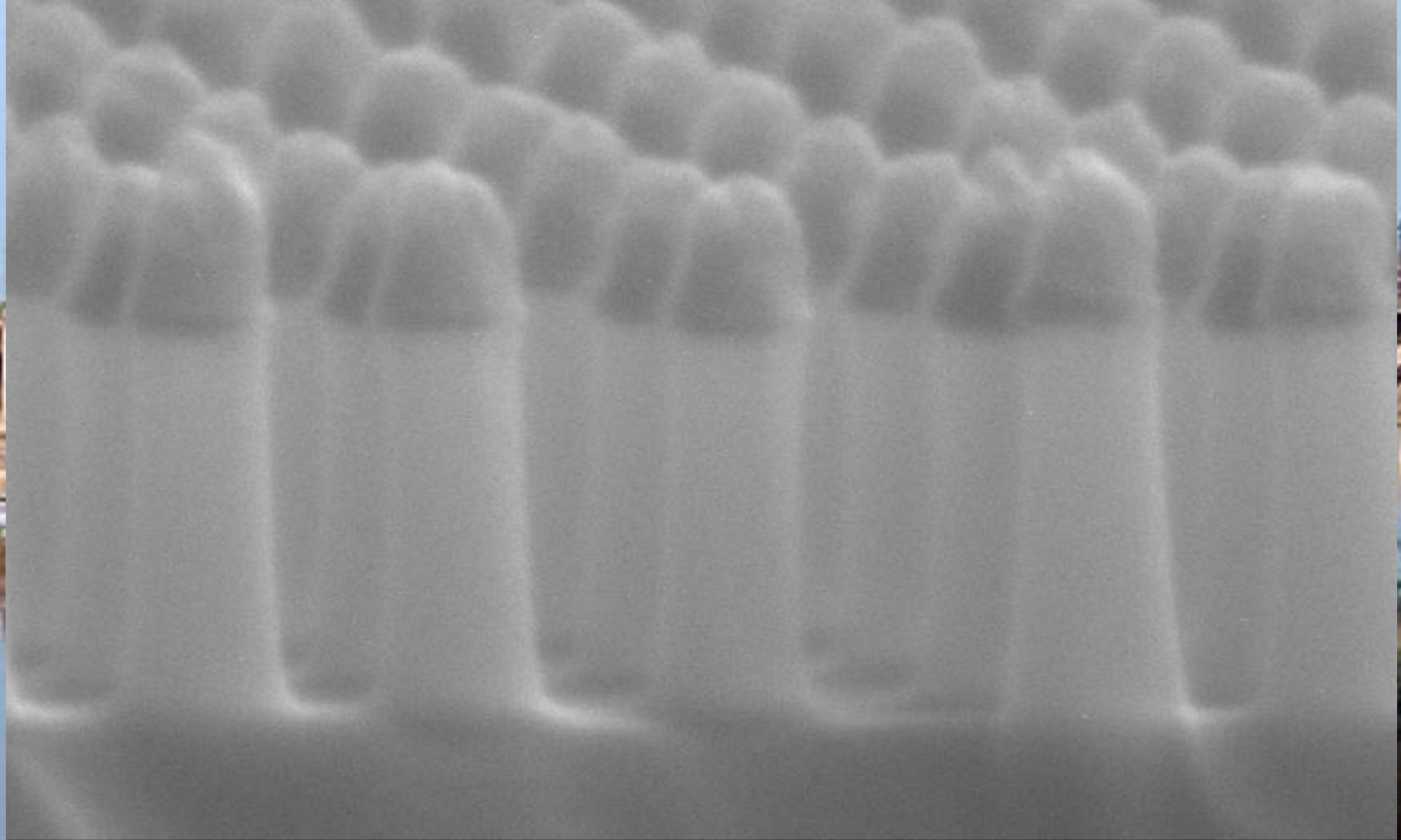
Instrument: JEOL JSM-7001 - SEM
Affiliation: University of Southern California



2019 EIPBN MicroGraph Contest

Micrograph Title:
Nano origin of life

Description:
Array of nano pillars with gold cap. Made by nanoimprint lithography and reactive ion etching.



X 95,000 9.0kV SEI SEM 100nm 5/4/2016 WD 13.0mm 19:59:05

Magnification (3"x4" image): 95KX
Submitted by: Boxiang Song

Instrument : JEOL JSM 7001
Affiliation: Univ. of Southern California

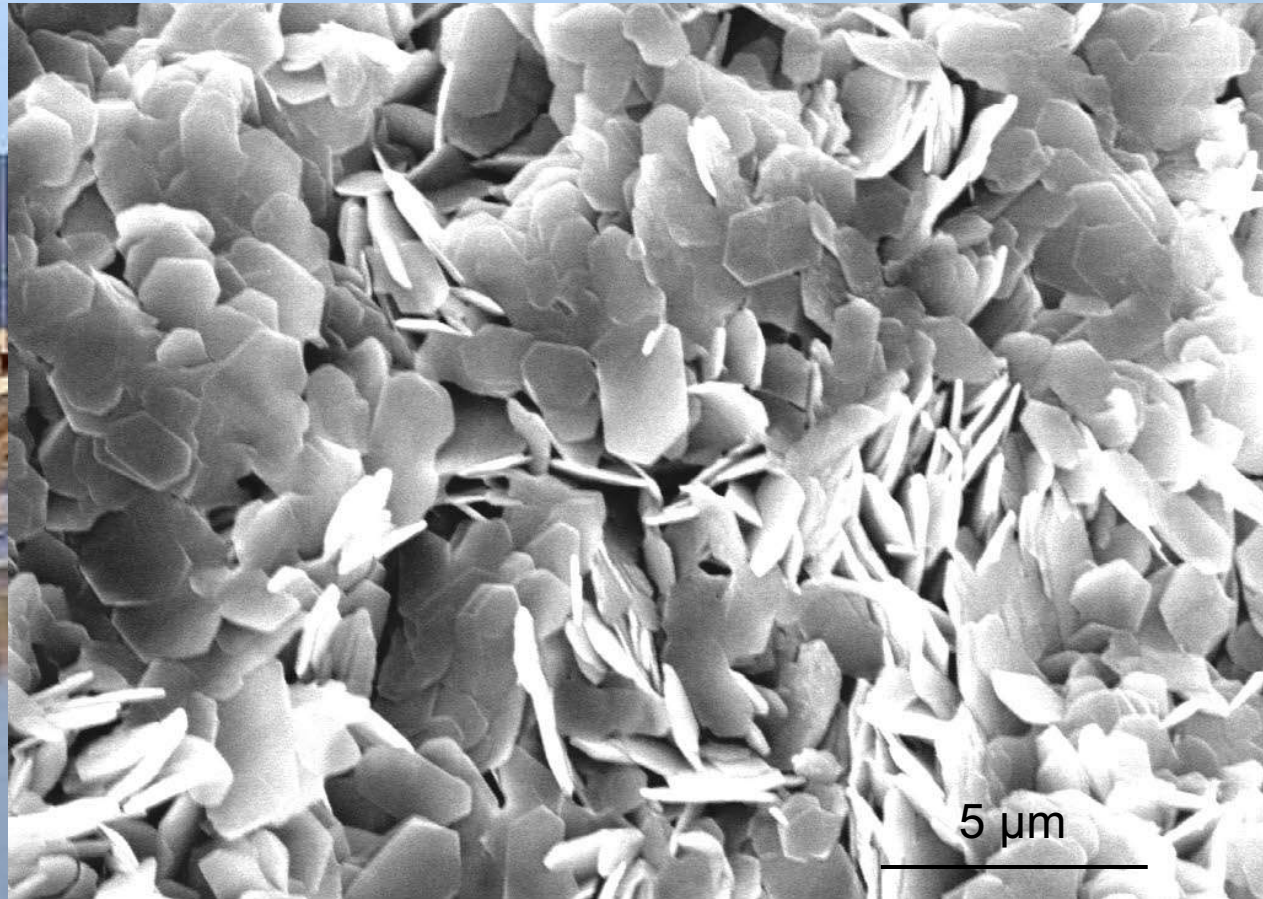


2019 EIPBN MicroGraph Contest

27

Micrograph Title:
Light Butterflies

Description:
Sunlit butterflies...
amongst graphene
platelets.



Magnification (3"x4" image): 5KX
Submitted by: Jessica M. Andriolo

Instrument : Hitachi S-4700
Affiliation: Montana Technological
University

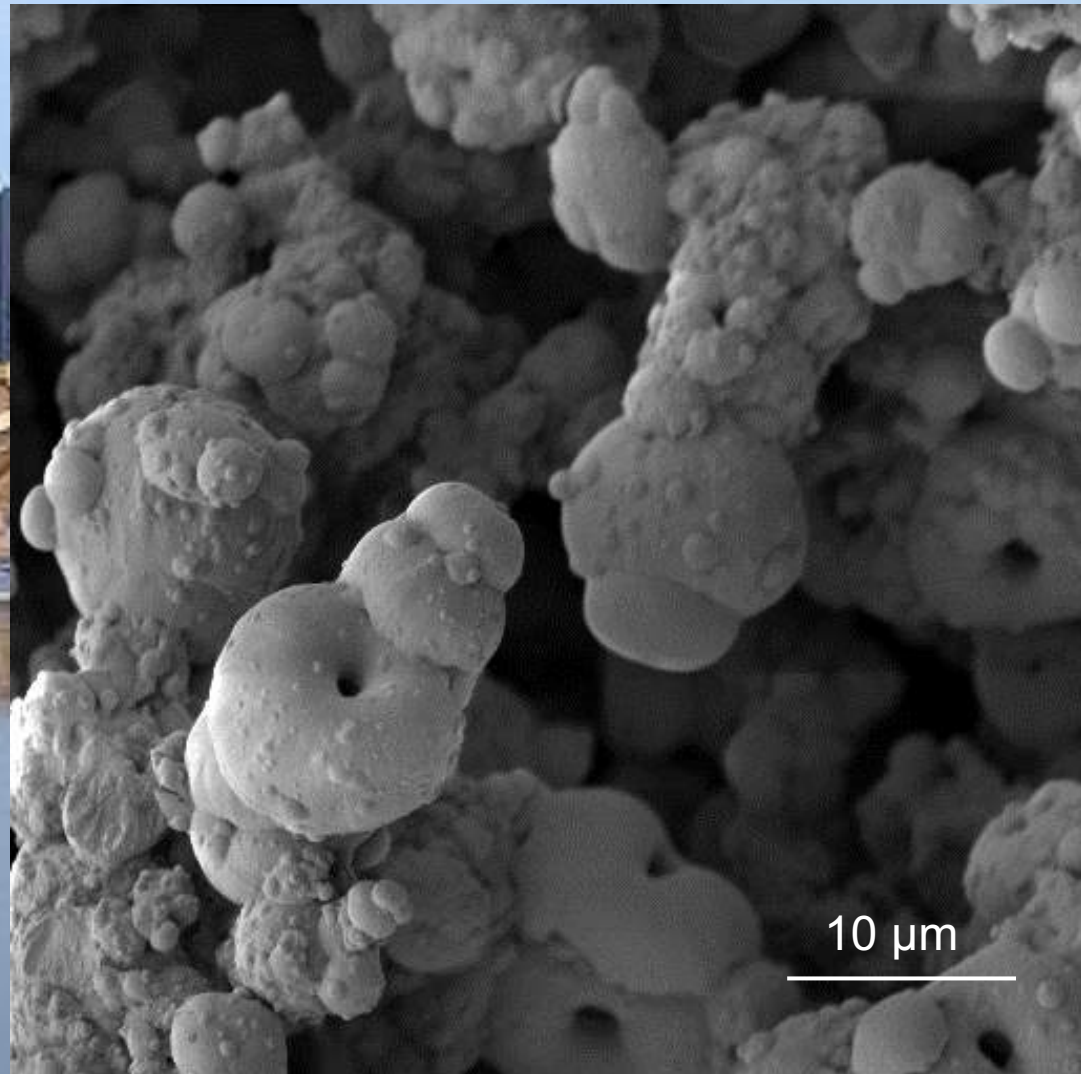


2019 EIPBN MicroGraph Contest

28

Micrograph Title:
Find the Lorax...
eating a donut.

Description:
Hungry Lorax eating
donuts in an
electrosprayed mat.



Magnification (3"x4" image): 1KX
Submitted by: Jessica M. Andriolo

Instrument : Tescan Mira 3
Affiliation: Montana Technological
University

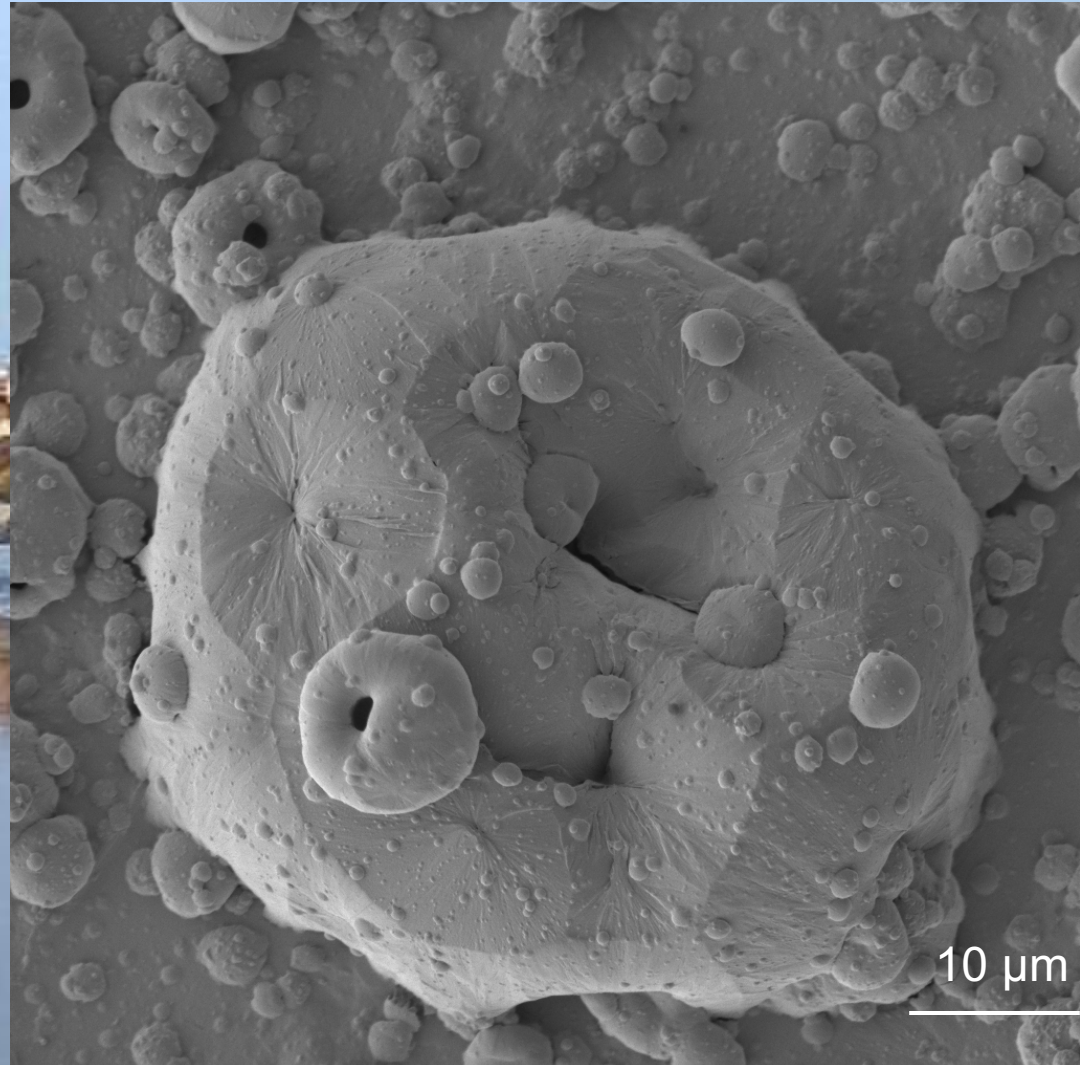


2019 EIPBN MicroGraph Contest

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Micrograph Title:
Cratered Space
Landmark

Description:
Electrosprayed
landmarks found
during planet
exploration.

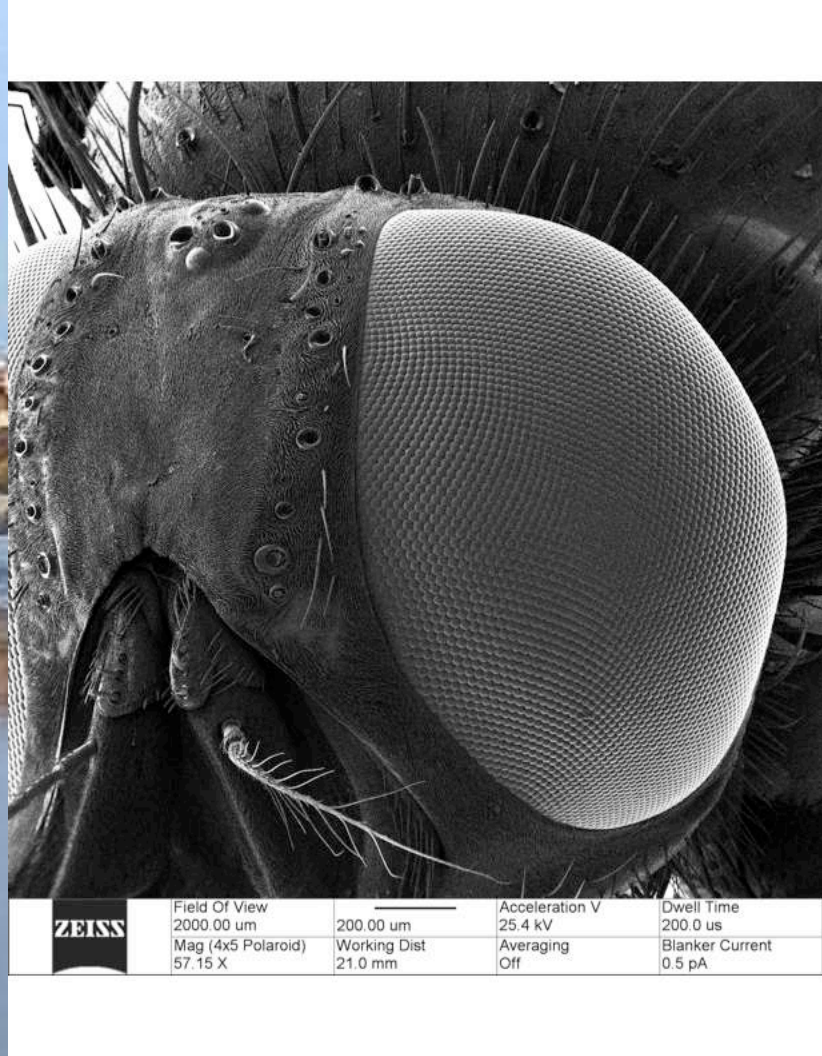


Magnification (3"x4" image): 1KX
Submitted by: Jessica M. Andriolo

Instrument : Tescan Mira 3
Affiliation: Montana Technological
University

Invader from outer space

Made using the Helium ion microscope. The fine detail and depth of focus are the special feature. A fly's eye.

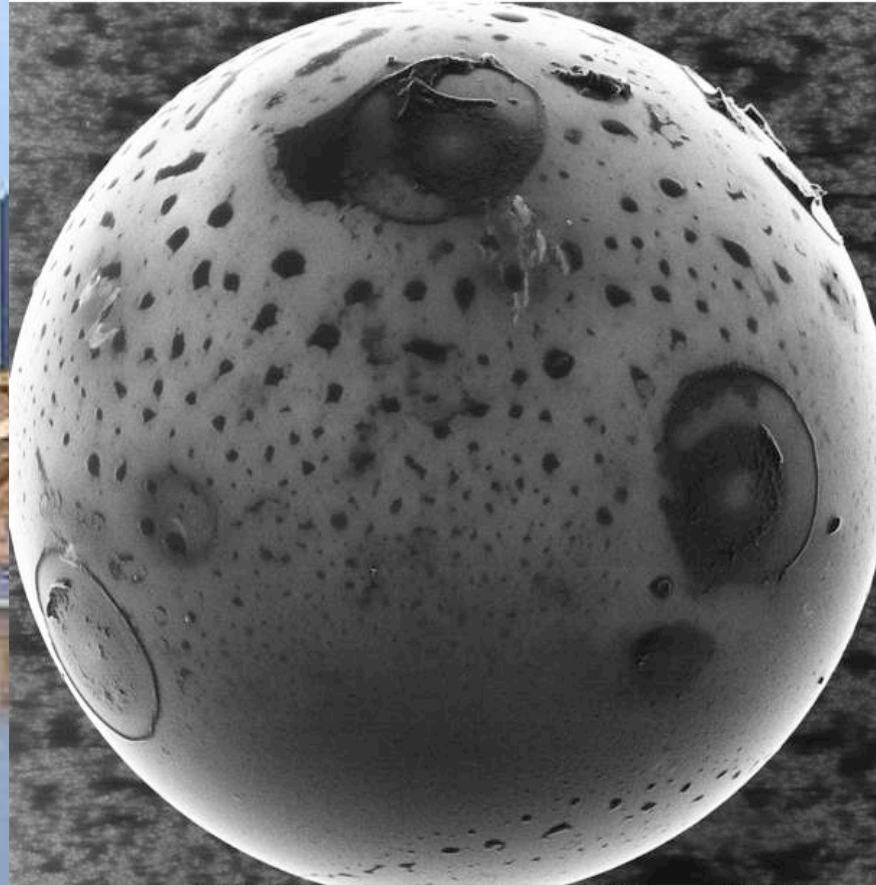




Magnification (3"x4" image): 57X
 Submitted by: Mark Mondol

Instrument : Zeiss He ion microscope
 Affiliation: MIT

New exoplanet

Sapphire sphere



	Field Of View		Acceleration V	Dwell Time
	95.00 um	10.00 um	34.9 kV	10.0 us
	Mag (4x5 Polaroid)	Working Dist	Detector	Blanker Current
	1,203.16 X	14.5 mm	PrimaryETDetector	0.2 pA

Magnification (3"x4" image): 1.2KX

Submitted by: Mark Mondol

Instrument : Zeis He Ion microscope

Affiliation: MIT

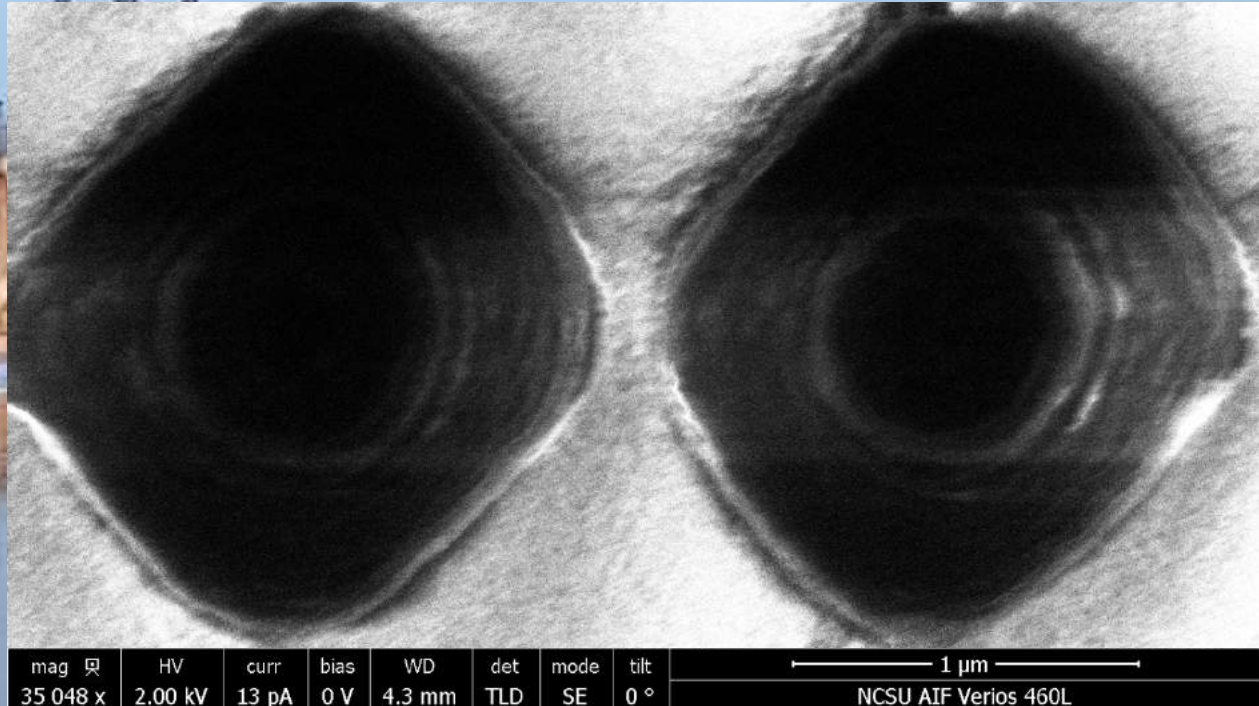


2019 EIPBN MicroGraph Contest

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Micrograph Title:
Into the Abyss

Description:
The SU8 pattern.

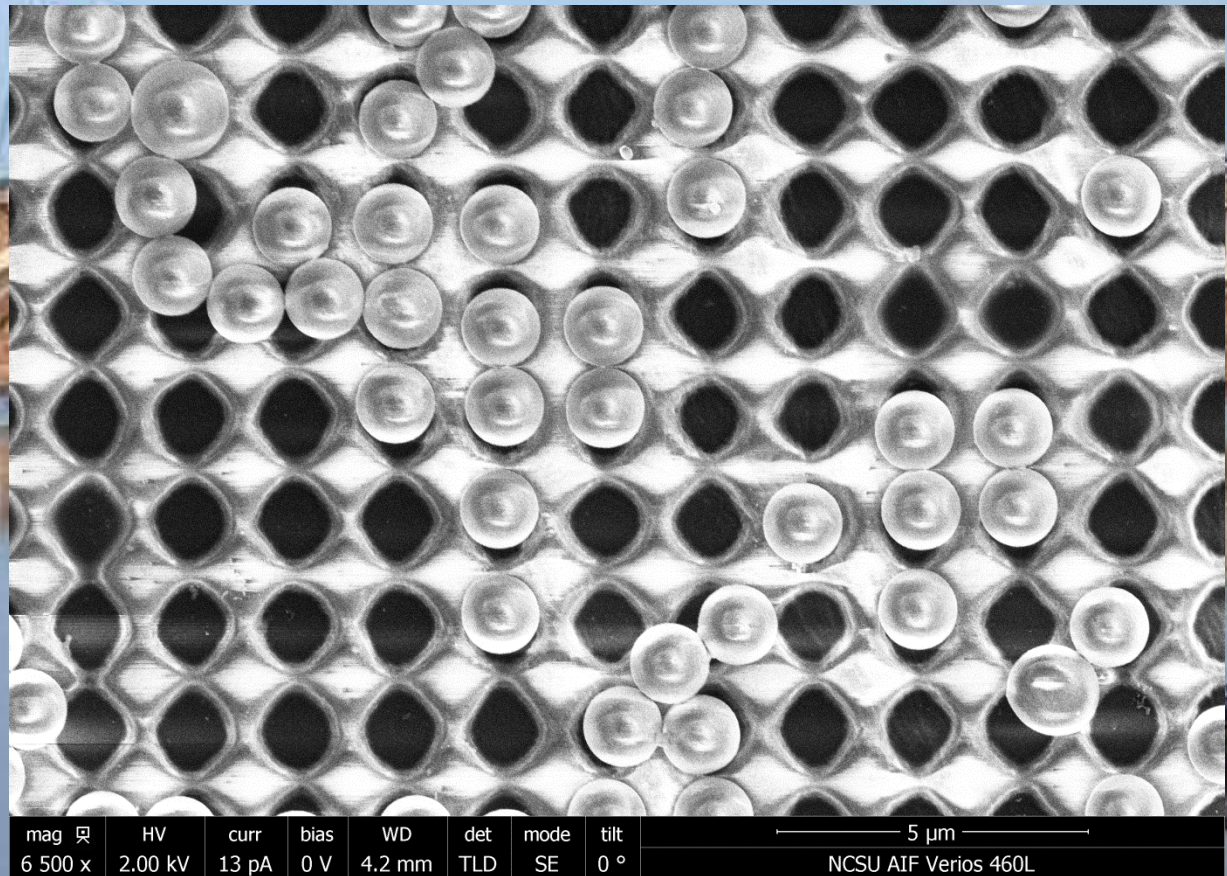


Magnification (3"x4" image): 2 KX
Submitted by: Zhiren Luo
University

Instrument : FEI Verios 460
Affiliation: North Carolina State

Micrograph Title:
Checkers

Description:
Polystyrene spheres
on the photoresist
pattern.



Magnification (3"x4" image): 2 KX

Submitted by: Zhiren Luo

University

Instrument : FEI Verios 460

Affiliation: North Carolina State



2019 EIPBN MicroGraph Contest

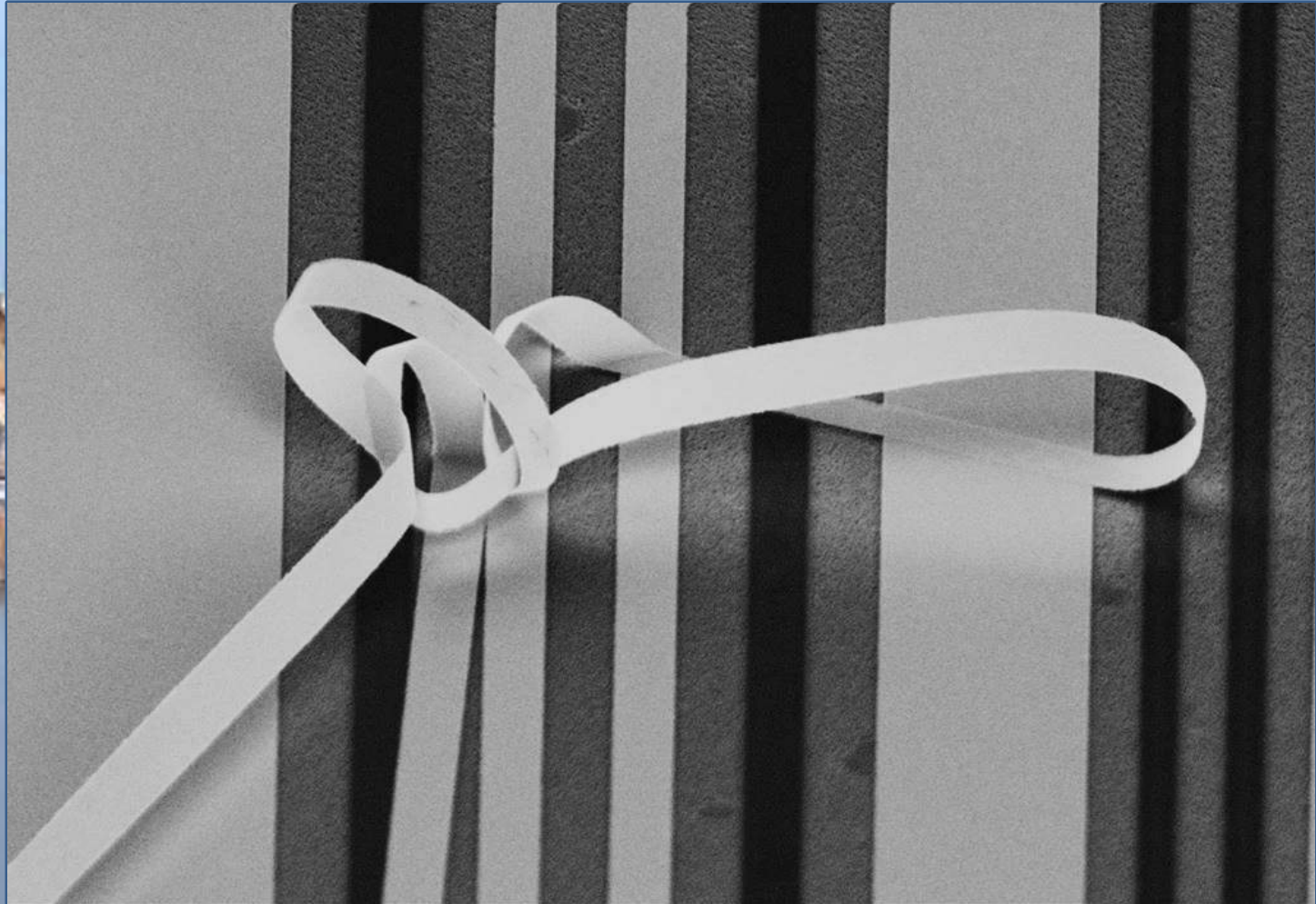
34

Micrograph Title:

**Ribbons for
micron scale
presents**

Description:

Poor adhesion during pattern transfer of metallic nanometer-thick features actually can give ideas for next Xmas?



Magnification (3"x4" image): 10KX

Submitted by: Gemma Rius

Instrument : LEO 1530 Zeiss

Affiliation: IMB-CNM-CSIC (Spain)

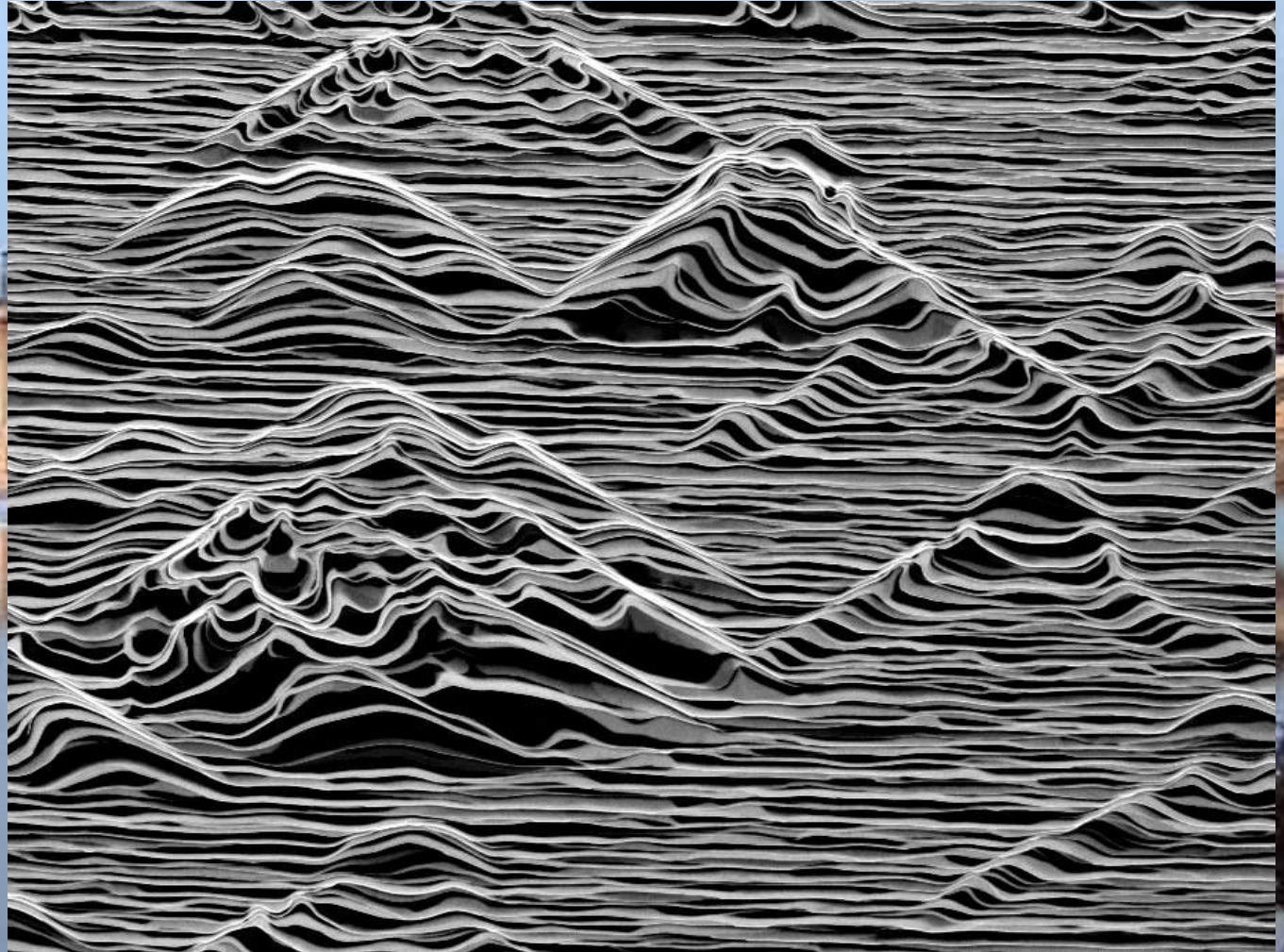


2019 EIPBN MicroGraph Contest

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Micrograph Title:

**Semiconductor
Dunes**



Description:

High temperature treatment of semiconductor is always risky, yet it can provide beautiful landscapes of a micrometer world

Magnification (3"x4" image): 25KX

Submitted by: Gemma Rius

Instrument : LEO 1530 Zeiss

Affiliation: IMB-CNM-CSIC (Spain)



2019 EIPBN MicroGraph Contest

36

Micrograph Title:
**Falling
elements**

Description:
Our new method for
micro/nano pattern
transfer tries
defying our
understanding of
their adhesion, with
the predominance of
a gravity
phenomenon!



Magnification (3"x4" image): 2KX
Submitted by: Gemma Rius

Instrument : LEO 1530 Zeiss
Affiliation: IMB-CNM-CSIC (Spain)

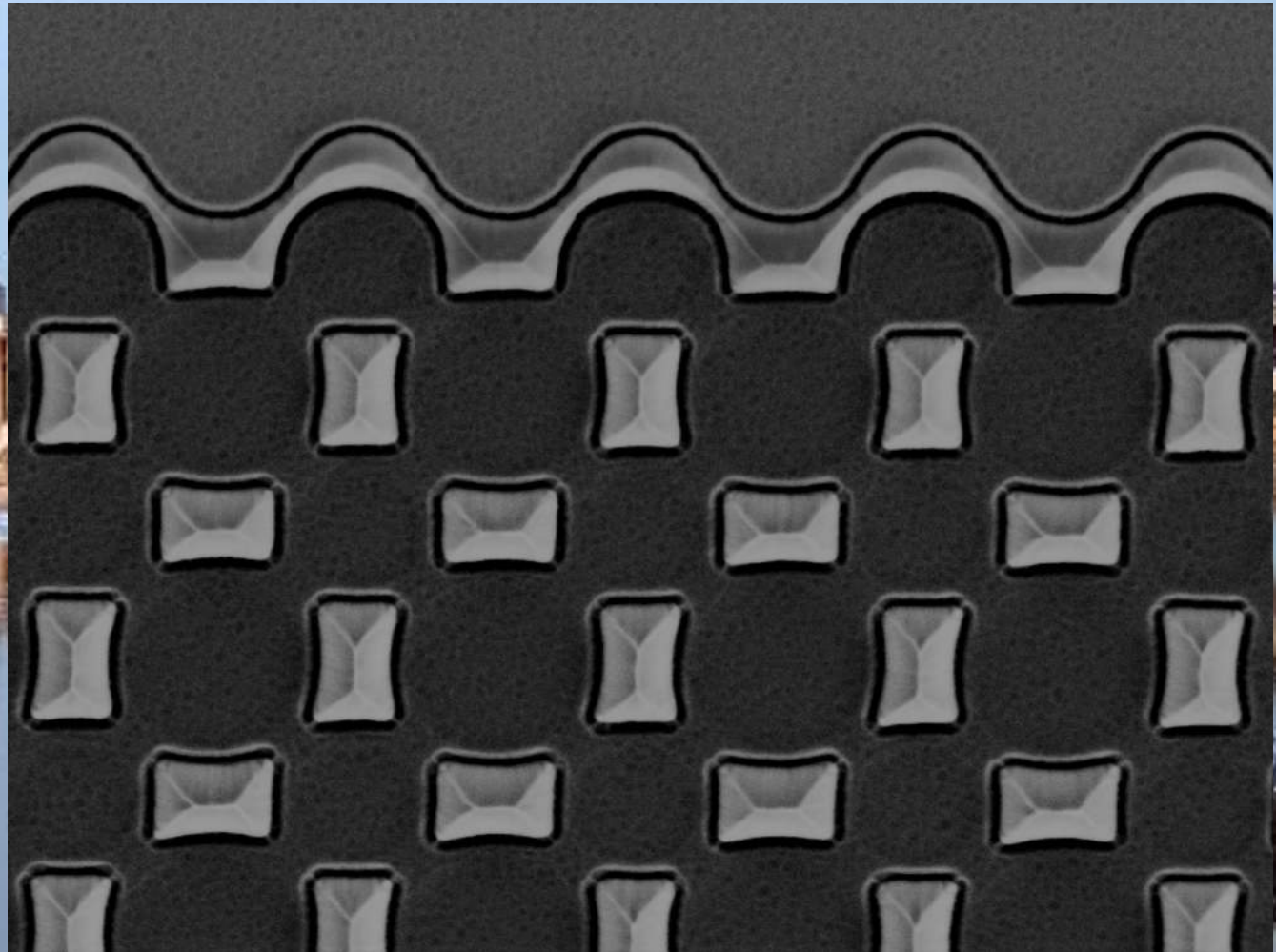


2019 EIPBN MicroGraph Contest

37

Micrograph Title:
**Gaudi at the
microscale**

Description:
Gaudi-style curves are very well known, at the macroscopic scale, but we catalans have challenged to reproduce them really small !



Magnification (3"x4" image): 10KX
Submitted by: Gemma Rius

Instrument : LEO 1530 Zeiss
Affiliation: IMB-CNM-CSIC (Spain)

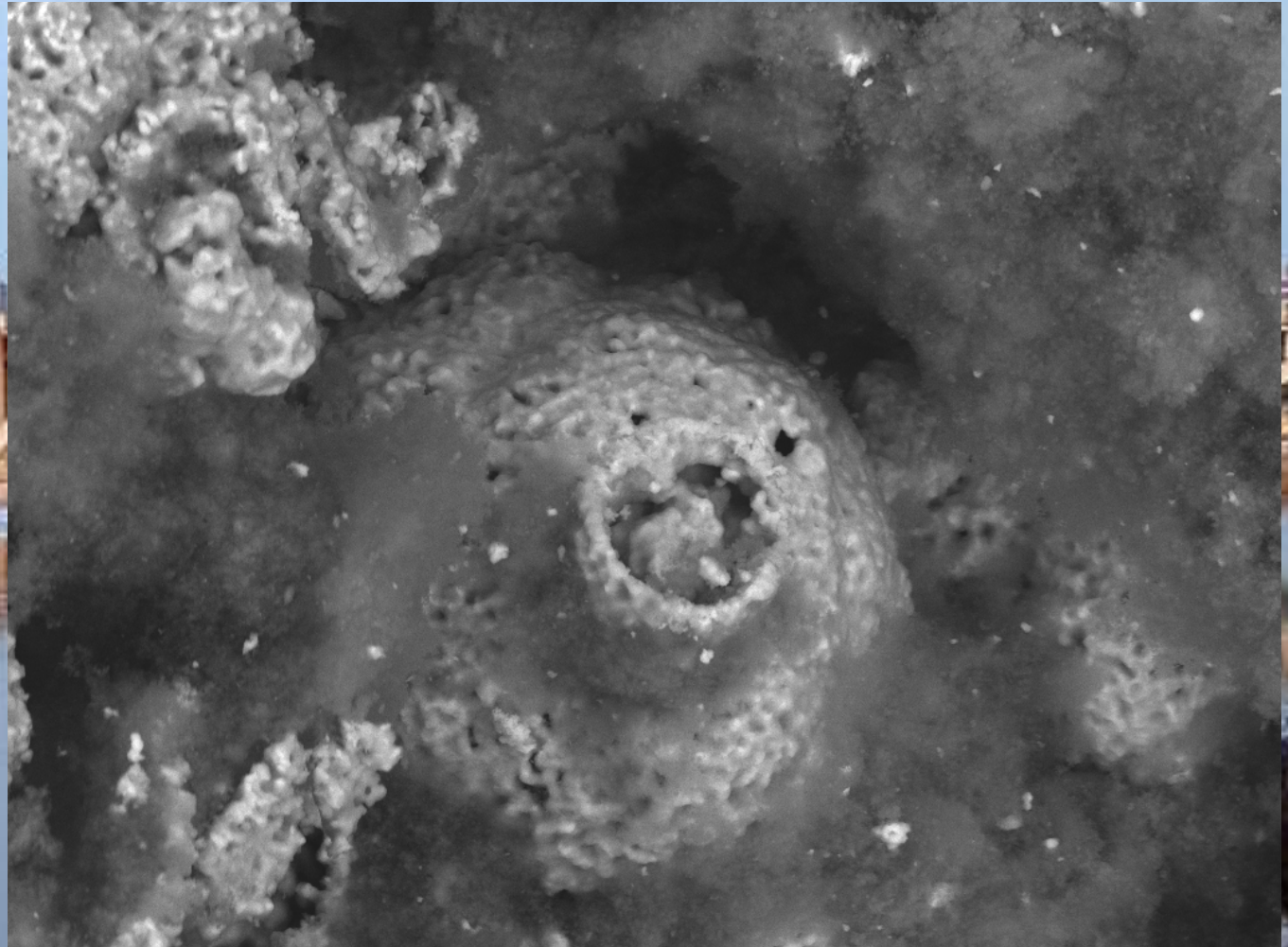


2019 EIPBN MicroGraph Contest

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Micrograph Title:
Screaming Eel

Description
 Mn_3O_4 eel hiding
in the
carbonaceous
cave of a
composite
electrode .



Magnification (3"x4" image): 3.51 KX

Submitted by: Molly Brockway

Instrument : Tescan Mira3

Affiliation: Montana Technological U.
Butte, MT

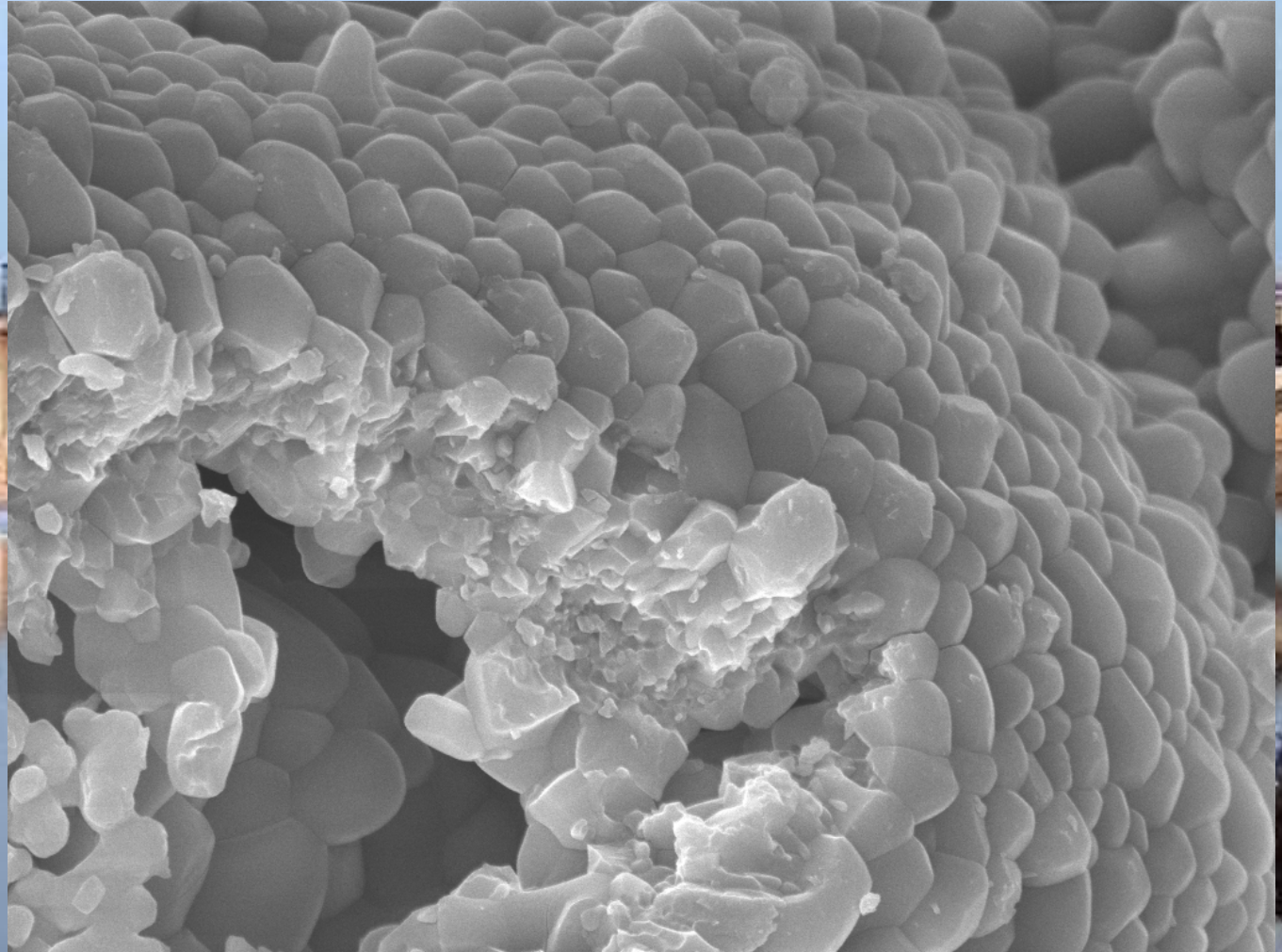


2019 EIPBN MicroGraph Contest

39

Micrograph Title:
Geode cave

Description:
The highly crystalline cave of a Mn_3O_4 hollow structure. Adventurers beware!



Magnification (3"x4" image): 18 KX
Submitted by: Molly Brockway

Instrument : Tescan Mira3
Affiliation: Montana Technological U.
Butte, MT

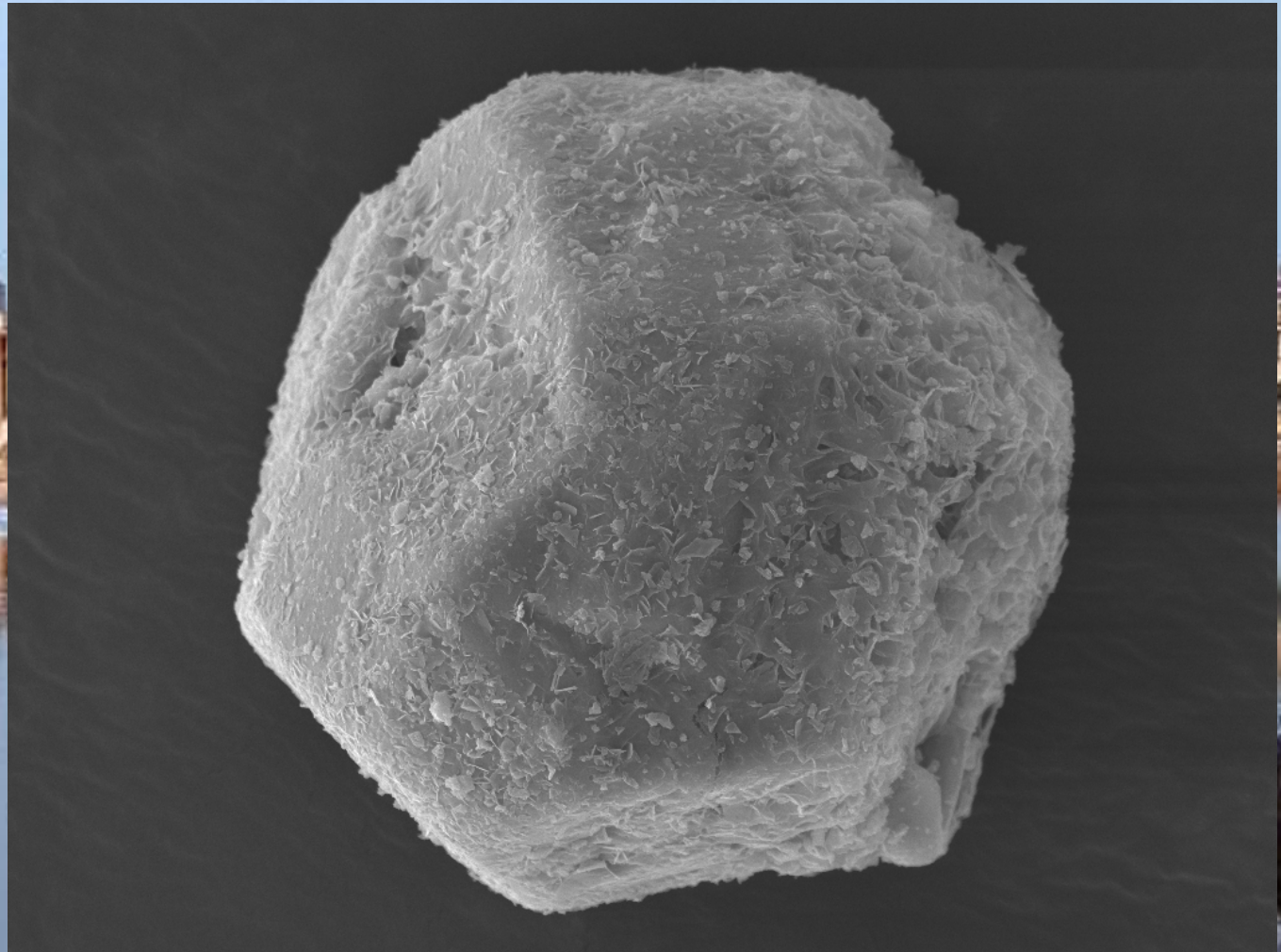


2019 EIPBN MicroGraph Contest

40

Micrograph Title:
If Gnats Played
Dungeons and
Dragons This Would
Be Useful

Description:
What is this, a game
for ants?? This 20-
micron d12 is made
for the tiniest
barbarian that ever
rolled a hit die. As-
synthesized MnS
crystallite.



Magnification (3"x4" image): 8.5 KX

Submitted by: Molly Brockway

Instrument : Target SEM - 101

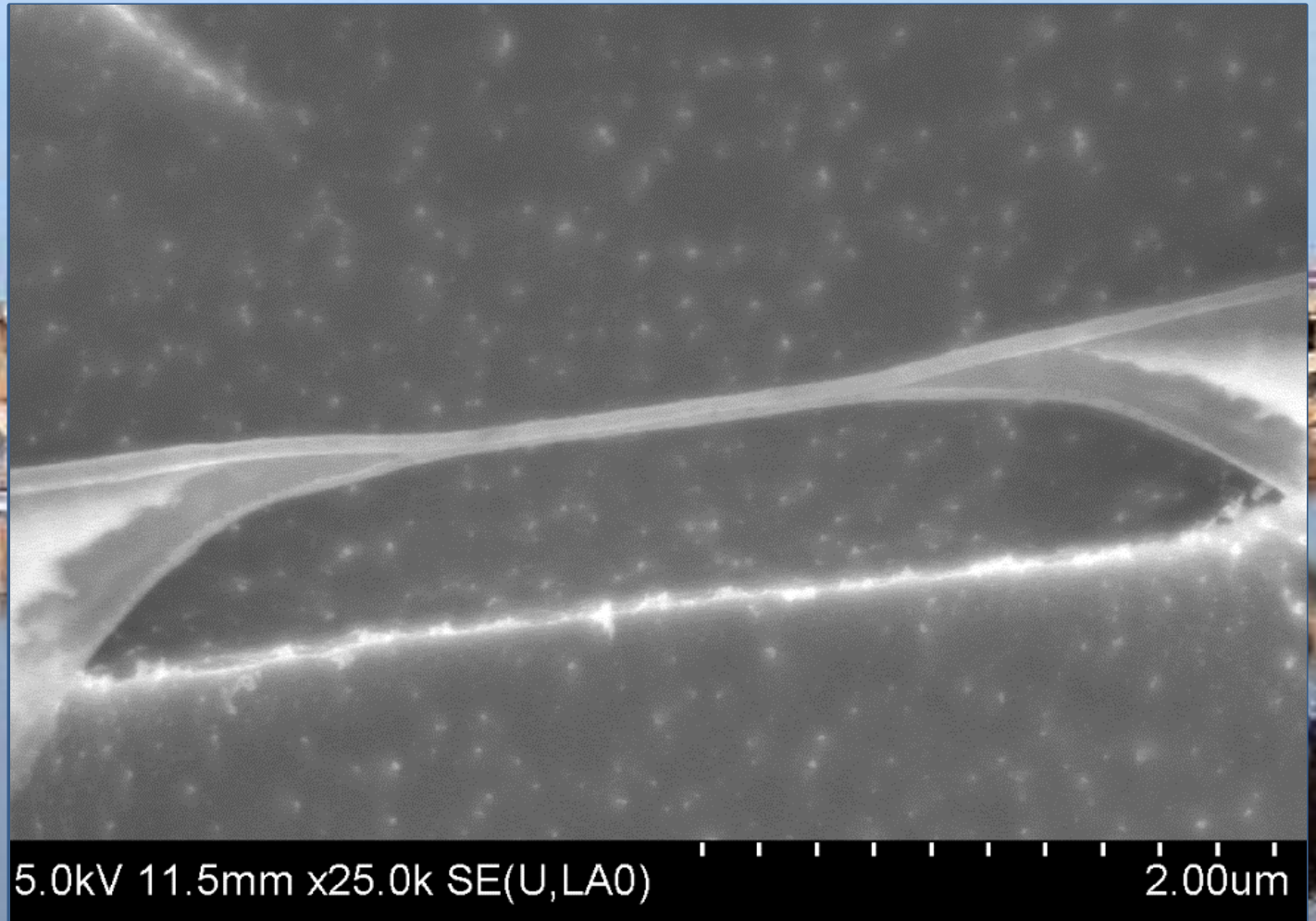
Affiliation: Montana Technological U.
Butte, MT



2019 EIPBN MicroGraph Contest

41

Micrograph Title:
Nano-bridge



Description:
During ICP-RIE Si etching, undercut formed while using PMMA + Alumina hybrid resist mask lead to suspended bridge nanostructure

Magnification : 25KX
Submitted by: Nikhil Tiwale

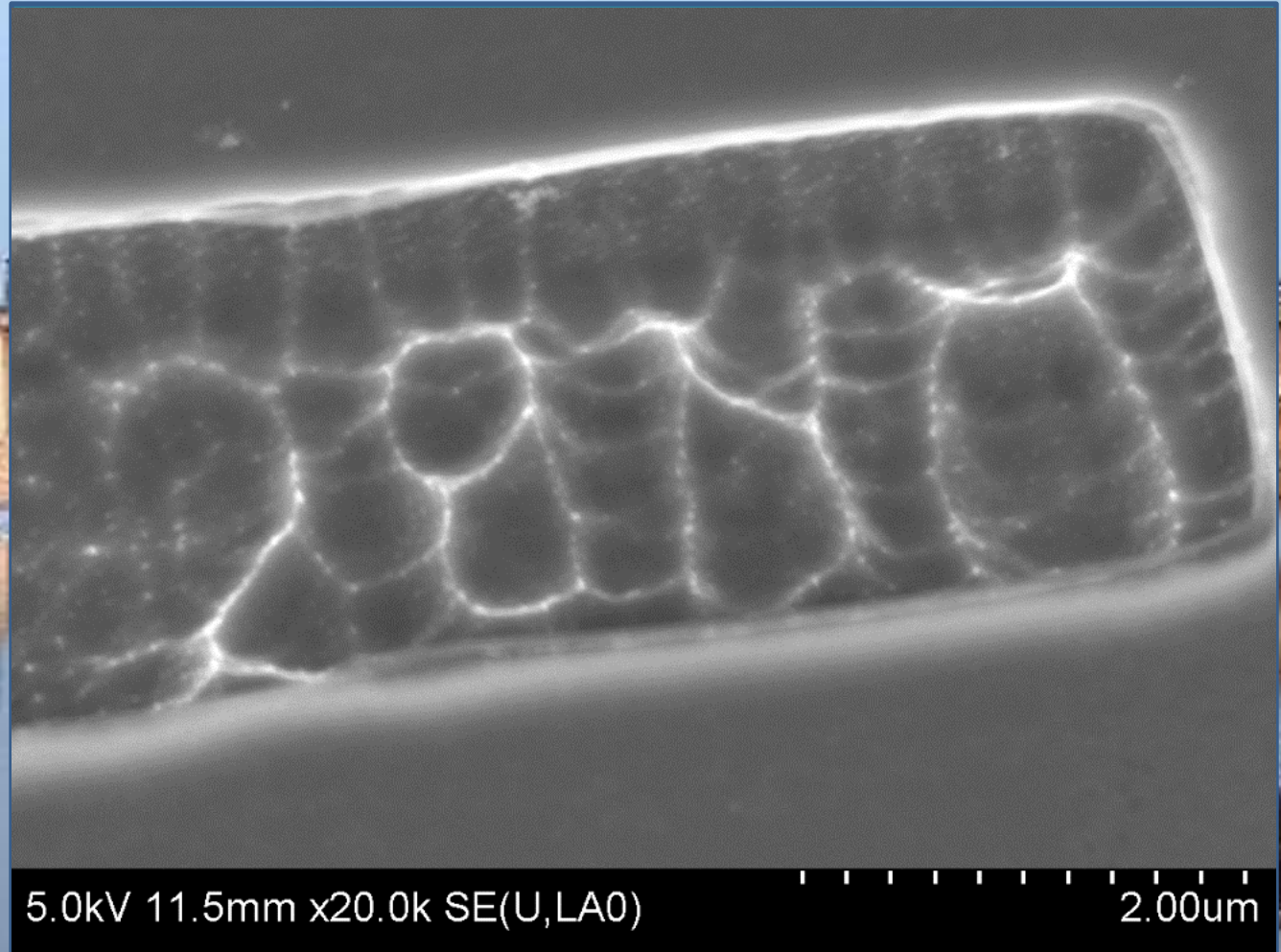
Instrument : Hitachi 4800 SEM
Affiliation: Brookhaven National Laboratory
Upton NY, USA



2019 EIPBN MicroGraph Contest

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Micrograph Title:
Horror at Nanoscale



5.0kV 11.5mm x20.0k SE(U,LA0)

2.00um

Description:
Due to the undercut formation, as a consequence of high SF_6 ratio, during ICP-RIE Si etch, can lead to lifting off resist mask and leave eroded etched structure

Magnification : 20KX

Submitted by: Nikhil Tiwale

Instrument : Hitachi 4800 SEM

Affiliation: Brookhaven National Laboratory
Upton NY, USA

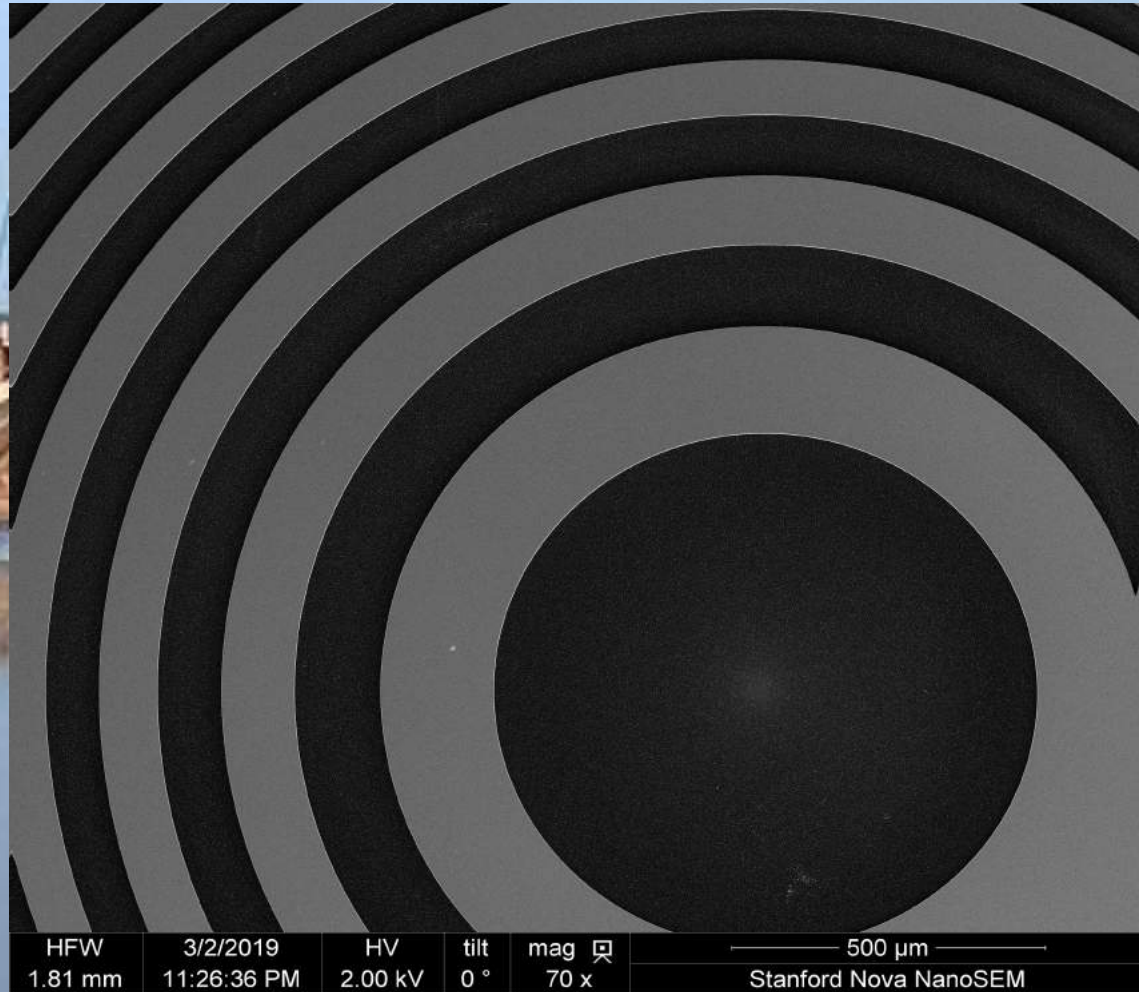


2019 EIPBN MicroGraph Contest

43

Micrograph Title:
Shades of Grey

Description:
Black Silicon
fabricated by
Reactive-Ion Etching
in a Holographic
Fiducial Mark



Magnification (3"x4" image): 70X

Submitted by: Maha Yusuf

Instrument : FEI Nova NanoSEM

Affiliation: Stanford University, CA

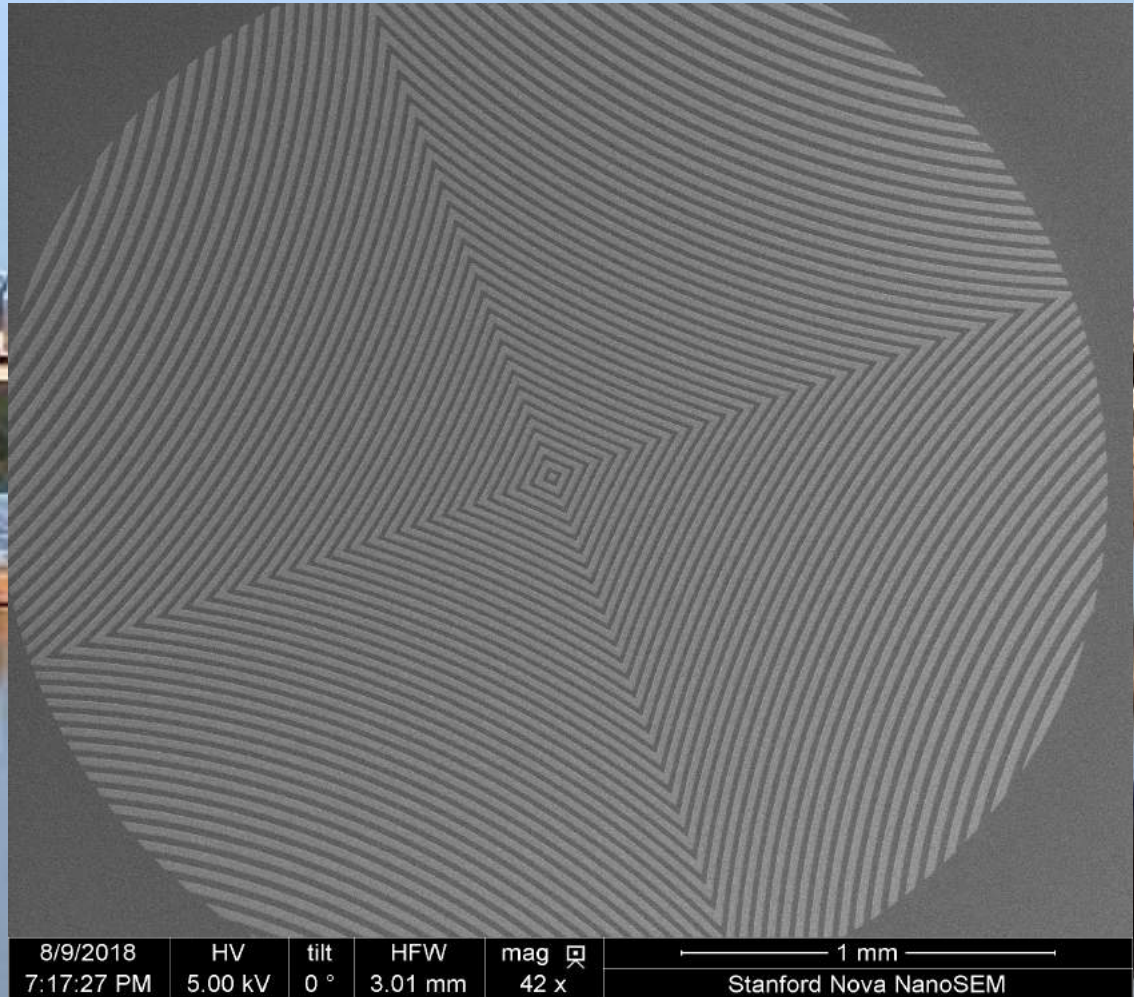


2019 EIPBN MicroGraph Contest

44

Micrograph Title:
A Circle of Squares

Description:
Alignment Mark
patterned using
mask-less, direct-
write
photolithography



Magnification (3"x4" image): 42X
Submitted by: Maha Yusuf

Instrument : FEI Nova NanoSEM
Affiliation: Stanford University, CA

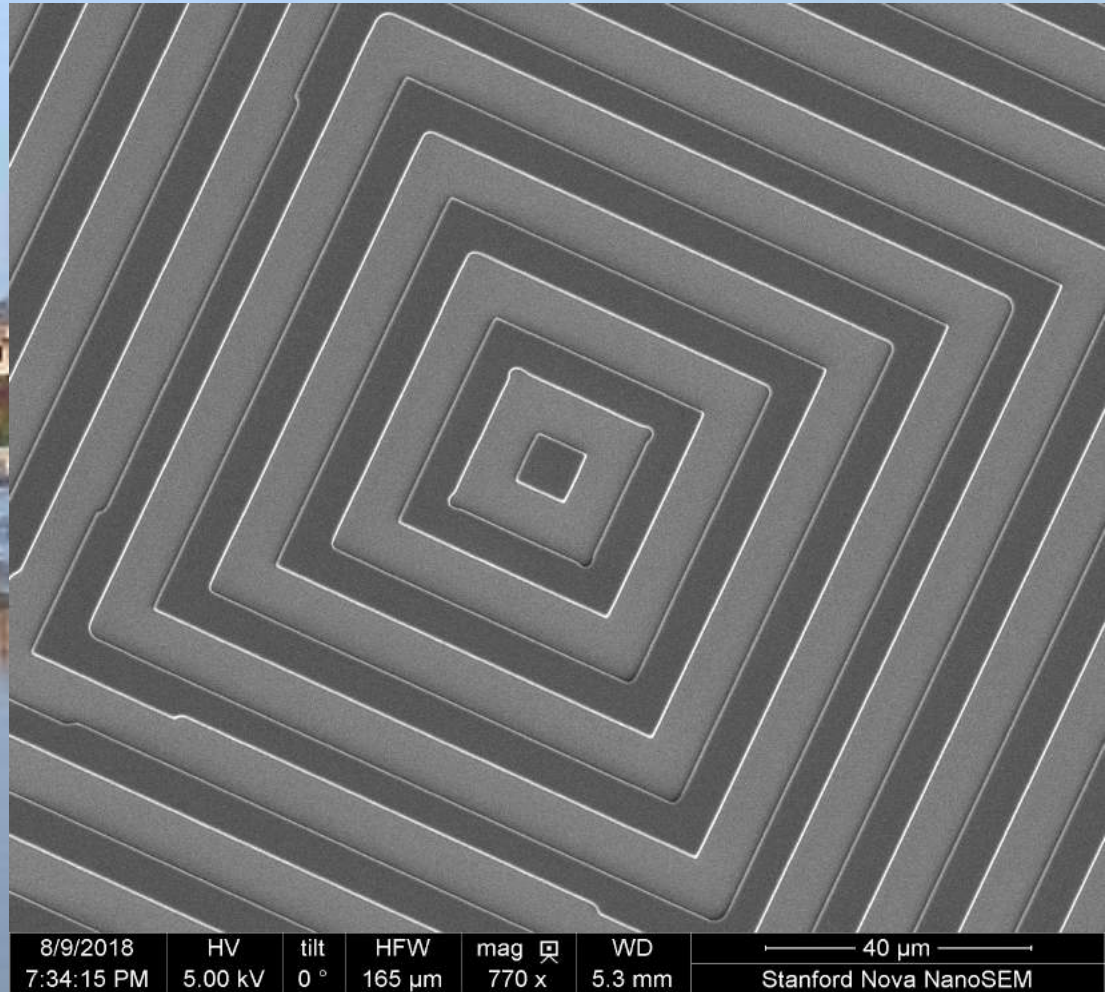


2019 EIPBN MicroGraph Contest

45

Micrograph Title:
Get lost in the
Spain's largest
Hedge Maze

Description:
Patterning of an
alignment mark
done using mask-
less, direct-write
photolithography



8/9/2018	HV	tilt	HFWD	mag	WD	40 μ m
7:34:15 PM	5.00 kV	0 °	165 μ m	770 x	5.3 mm	Stanford Nova NanoSEM

Magnification (3"x4" image): 770X
Submitted by: Maha Yusuf

Instrument: FEI Nova NanoSEM
Affiliation: Stanford University, CA

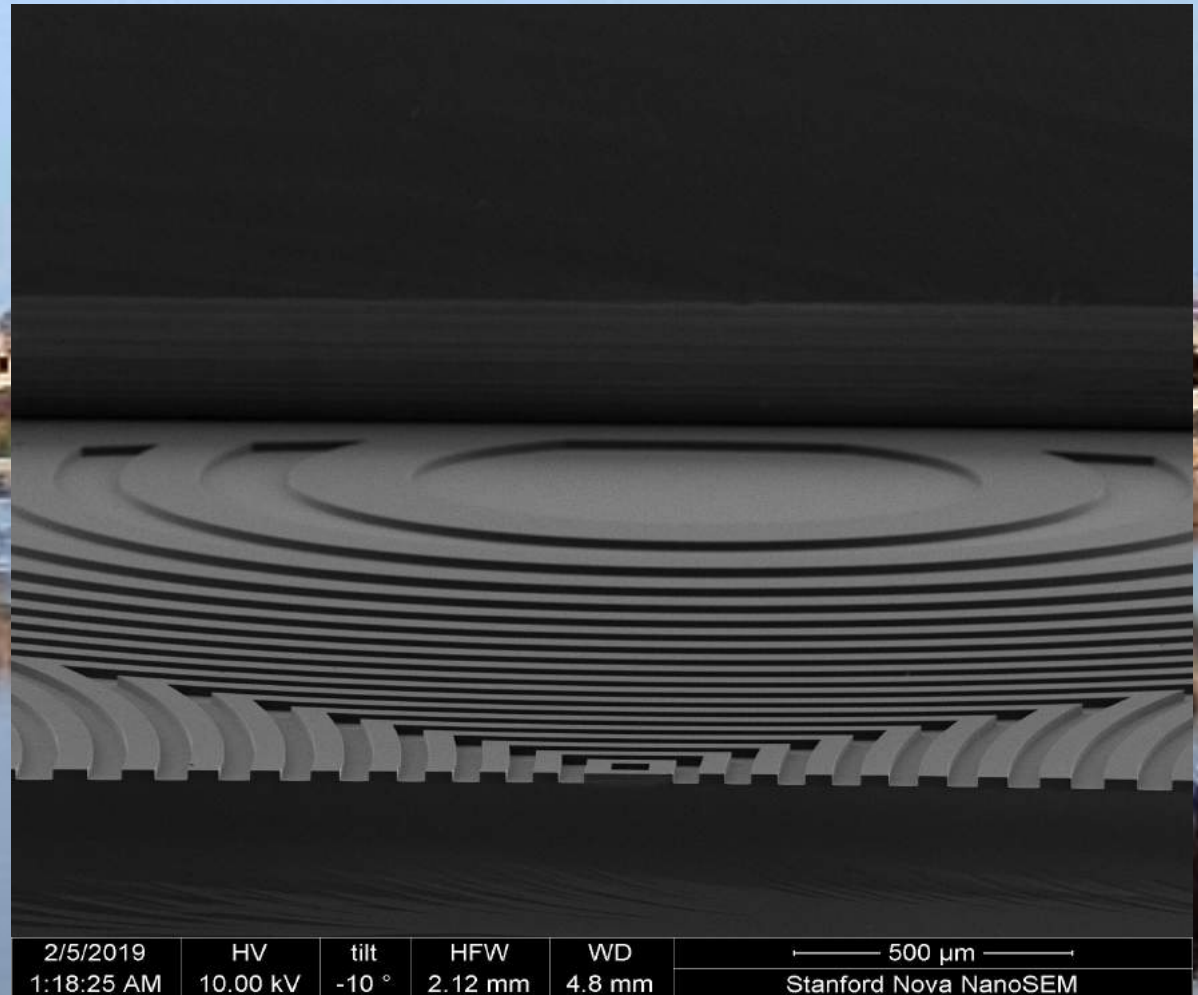


2019 EIPBN MicroGraph Contest

46

Micrograph Title:
Colosseum with
seating around

Description:
Tilted SEM image of
the fabricated
Holographic Fiducial
Mark using Mask-
less
Photolithography
and Reactive-Ion
Etching



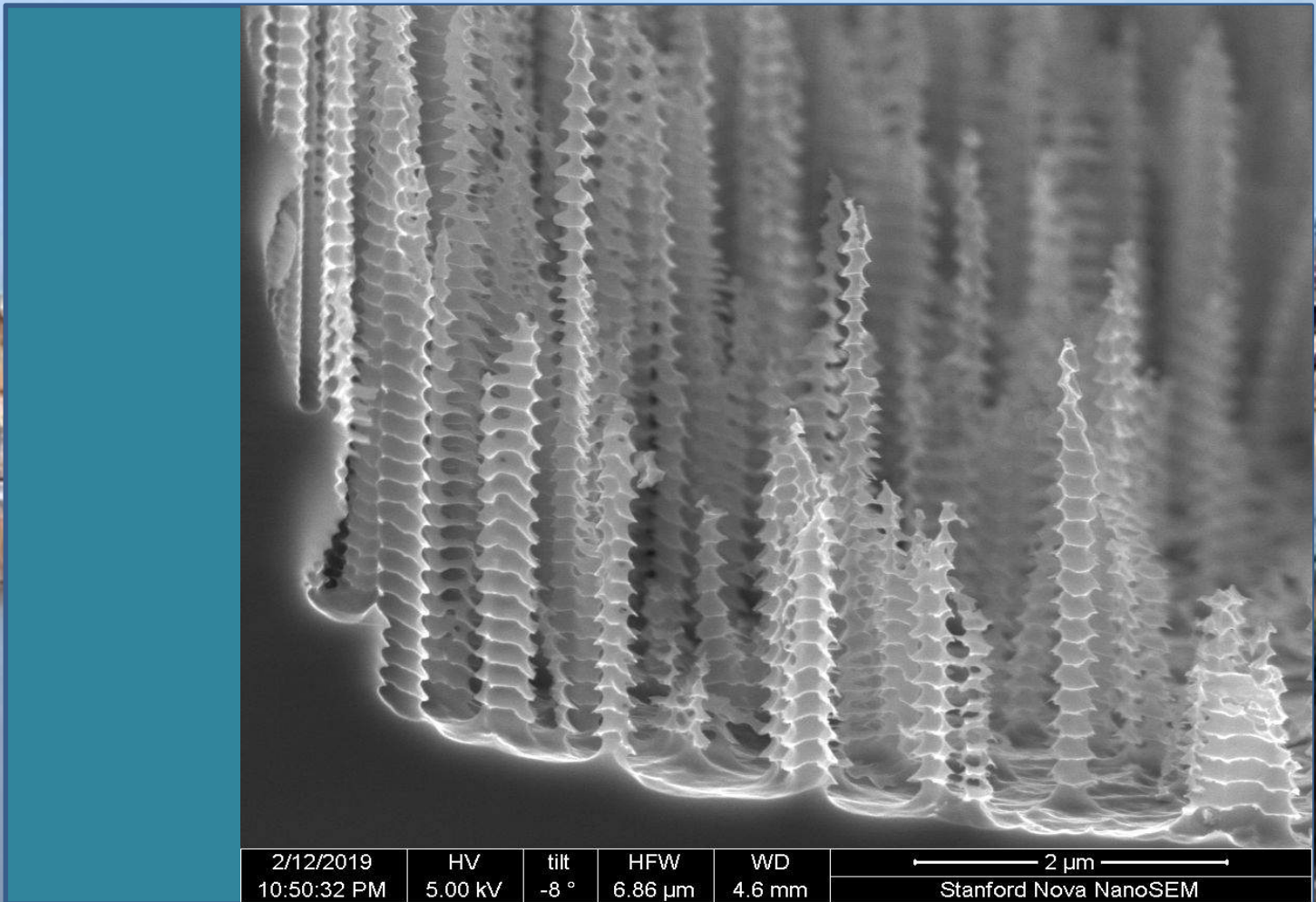
Horizontal Field Width: 2.12 mm
Submitted by: Maha Yusuf

Instrument : FEI Nova NanoSEM
Affiliation: Stanford University, CA

Micrograph Title:
Christmas Trees



Description:
 Silicon Micro-Structures fabricated using micro-masking in the Reactive-Ion Etching process



2/12/2019 10:50:32 PM	HV 5.00 kV	tilt -8 °	HFW 6.86 μm	WD 4.6 mm	 2 μm Stanford Nova NanoSEM
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Horizontal Field Width: 6.86 μm
Submitted by: Maha Yusuf

Instrument : FEI Nova NanoSEM
Affiliation: Stanford University, CA

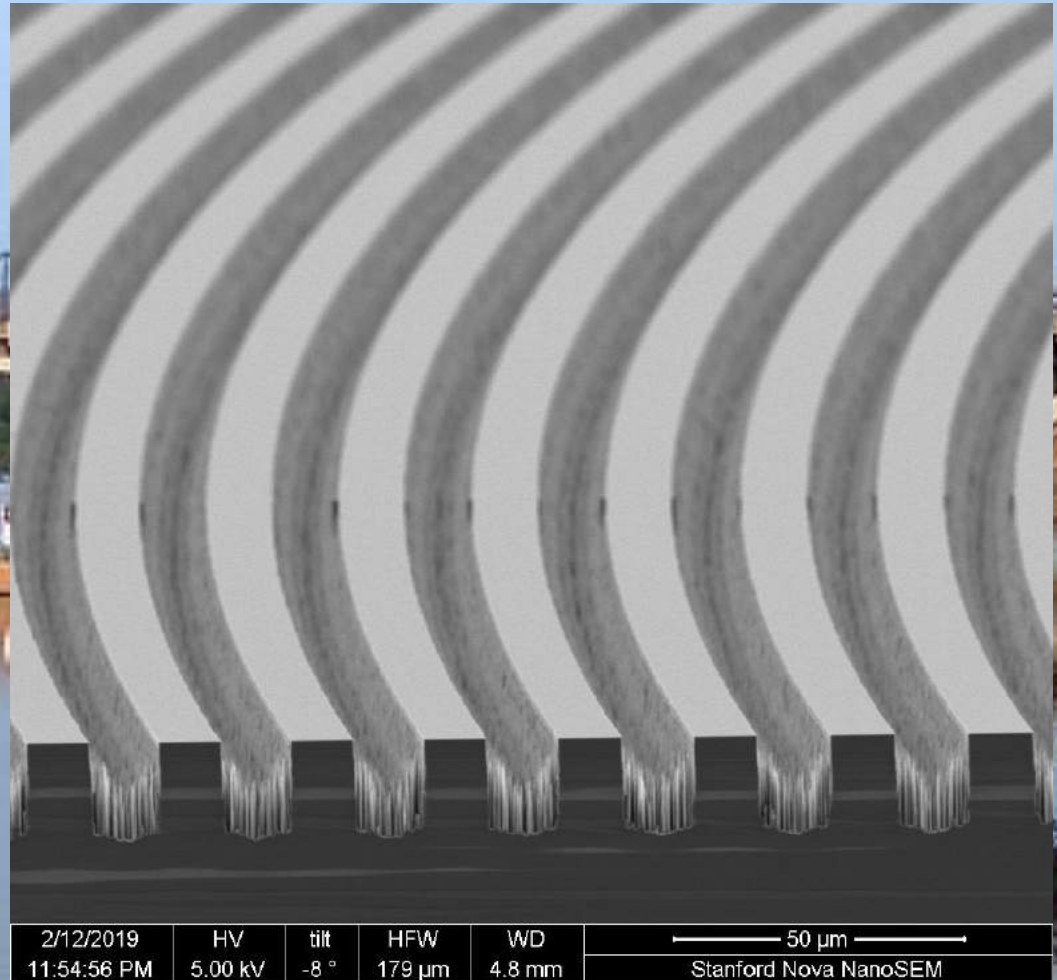


2019 EIPBN MicroGraph Contest

48

Micrograph Title:
Poisonous Snakes
with needle-like
fangs in their
mouths

Description:
Zoomed in photo of
the etched VS
unetched regions of
the holographic
fiducial mark
fabricated using
Reactive-Ion Etching
process



Horizontal Field Width: 179 μm
Submitted by: Maha Yusuf

Instrument : FEI Nova NanoSEM
Affiliation: Stanford University, CA

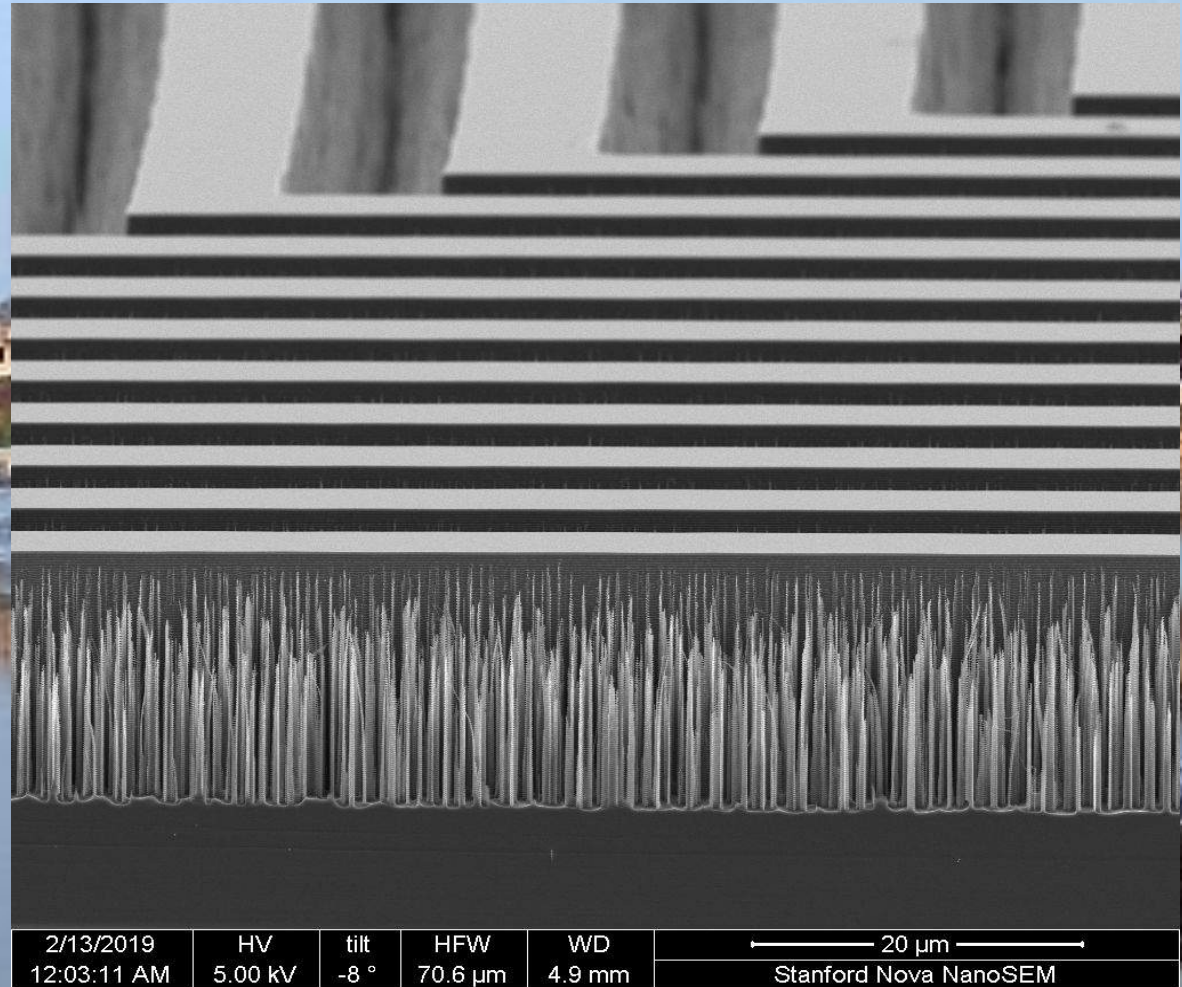


2019 EIPBN MicroGraph Contest

49

Micrograph Title:
Maze with thorns
and thistles in
between

Description:
Tilted Cross-
Sectional SEM
image of an
Alignment Mark
containing silicon
structures in the
etched areas,
fabricated using
Reactive-Ion Etching
process



2/13/2019 12:03:11 AM	HV 5.00 kV	tilt -8 °	HFWD 70.6 μm	WD 4.9 mm
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← 20 μm →
Stanford Nova NanoSEM

Horizontal Field Width: 70.6 μm
Submitted by: Maha Yusuf

Instrument : FEI Nova NanoSEM
Affiliation: Stanford University, CA

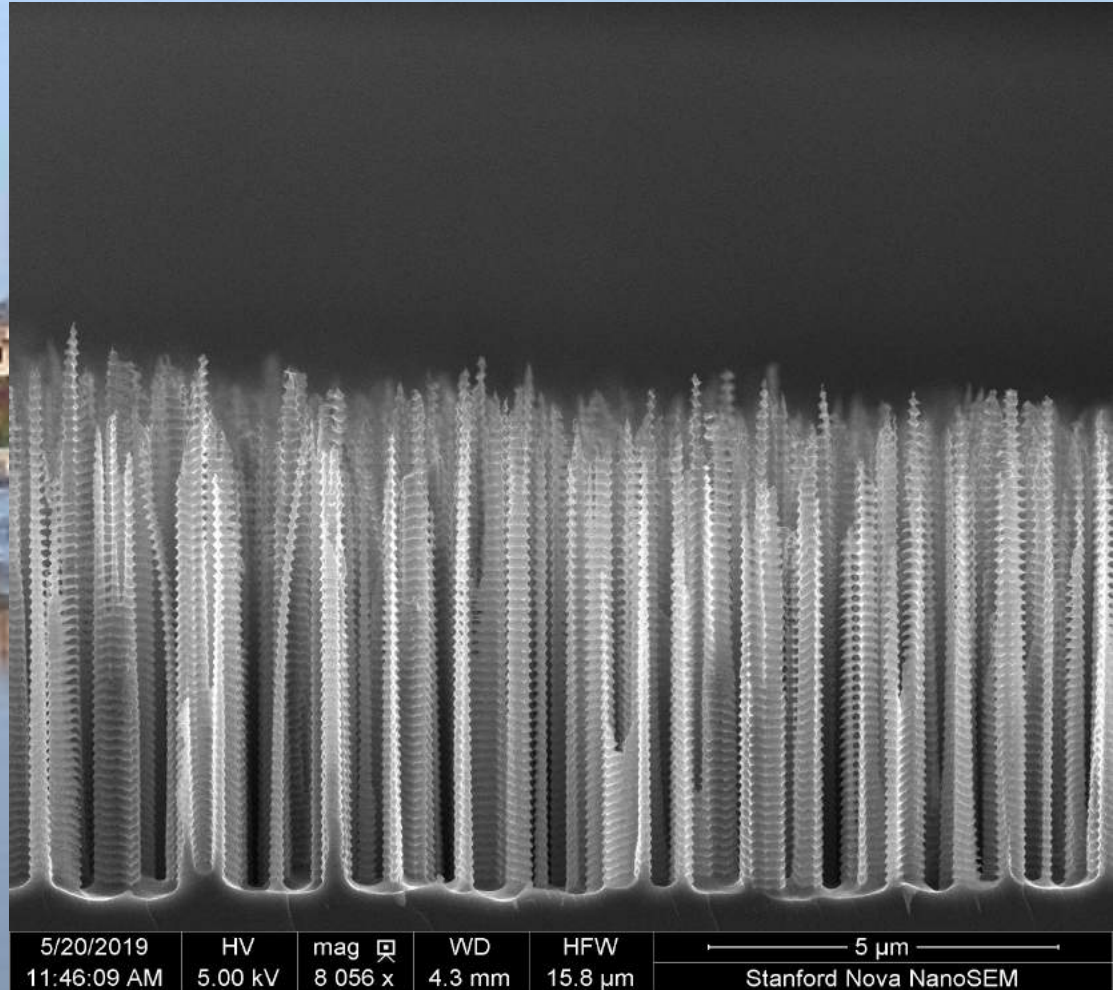


2019 EIPBN MicroGraph Contest

50

Micrograph Title:
Stand Tall and
Strong like Bamboo
Shoots

Description:
Silicon Micro-
Structures
fabricated using
Reactive-Ion Etching
Process

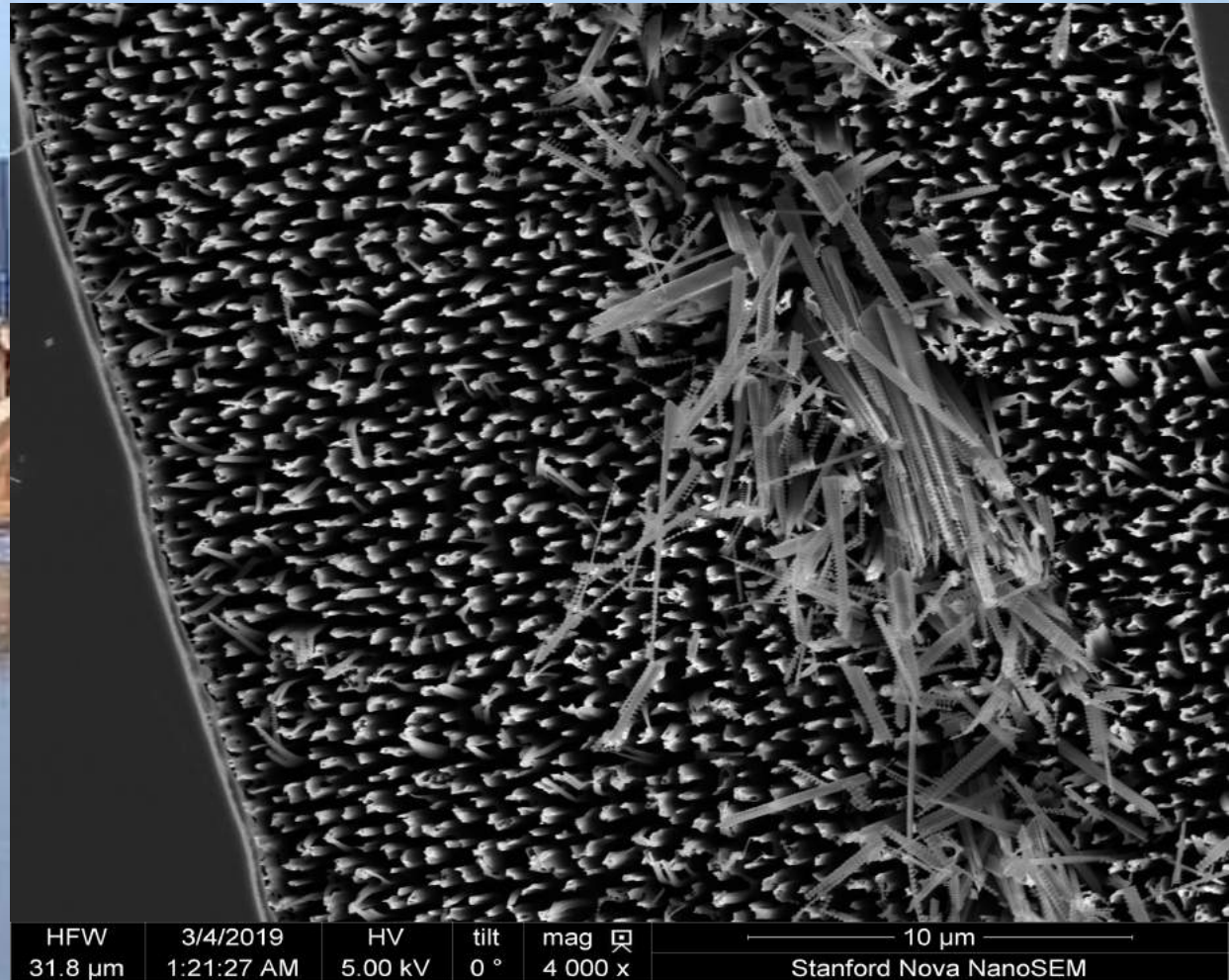


Magnification (3"x4" image): 8056X
Submitted by: Maha Yusuf

Instrument : FEI Nova NanoSEM
Affiliation: Stanford University, CA

Micrograph Title:
Chaos in the middle
of a battlefield

Description:
Broken Silicon
structures during
the silicon wafer
cleaving process



Horizontal Field Width: 31.8 μm

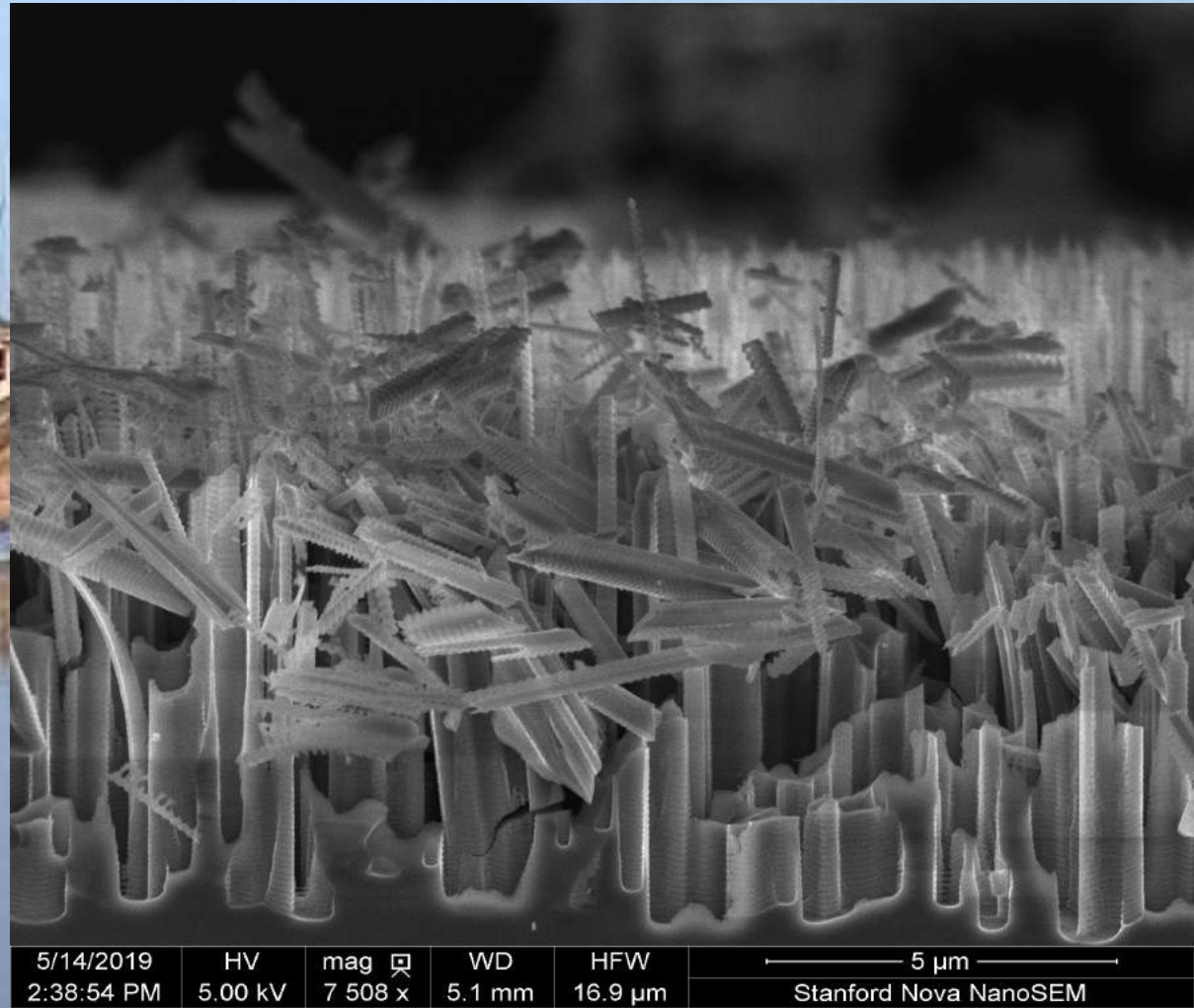
Submitted by: Maha Yusuf

Instrument : FEI Nova NanoSEM

Affiliation: Stanford University, CA

Micrograph Title:
 Daenerys Targaryen
 destroying Kings
 Landing with her
 dragons

Description:
 Broken Silicon
 micro/nano
 structures during
 the Silicon wafer
 cleaving process



Magnification (3"x4" image): 7508X
Submitted by: Maha Yusuf

Instrument : FEI Nova NanoSEM
Affiliation: Stanford University, CA



2019 EIPBN MicroGraph Contest

53

Micrograph Title:
When e-beam
lithography goes
wrong.

Description:
Copper / oxygen
dihydride core-shell
mm-scale nanotube
slightly over-etched
by naturally-
occurring high
energy beam of
electrons



Magnification (3"x4" image): 5X

Submitted by: James Owen

Instrument: iPhone XS

Affiliation: Zyvex Labs

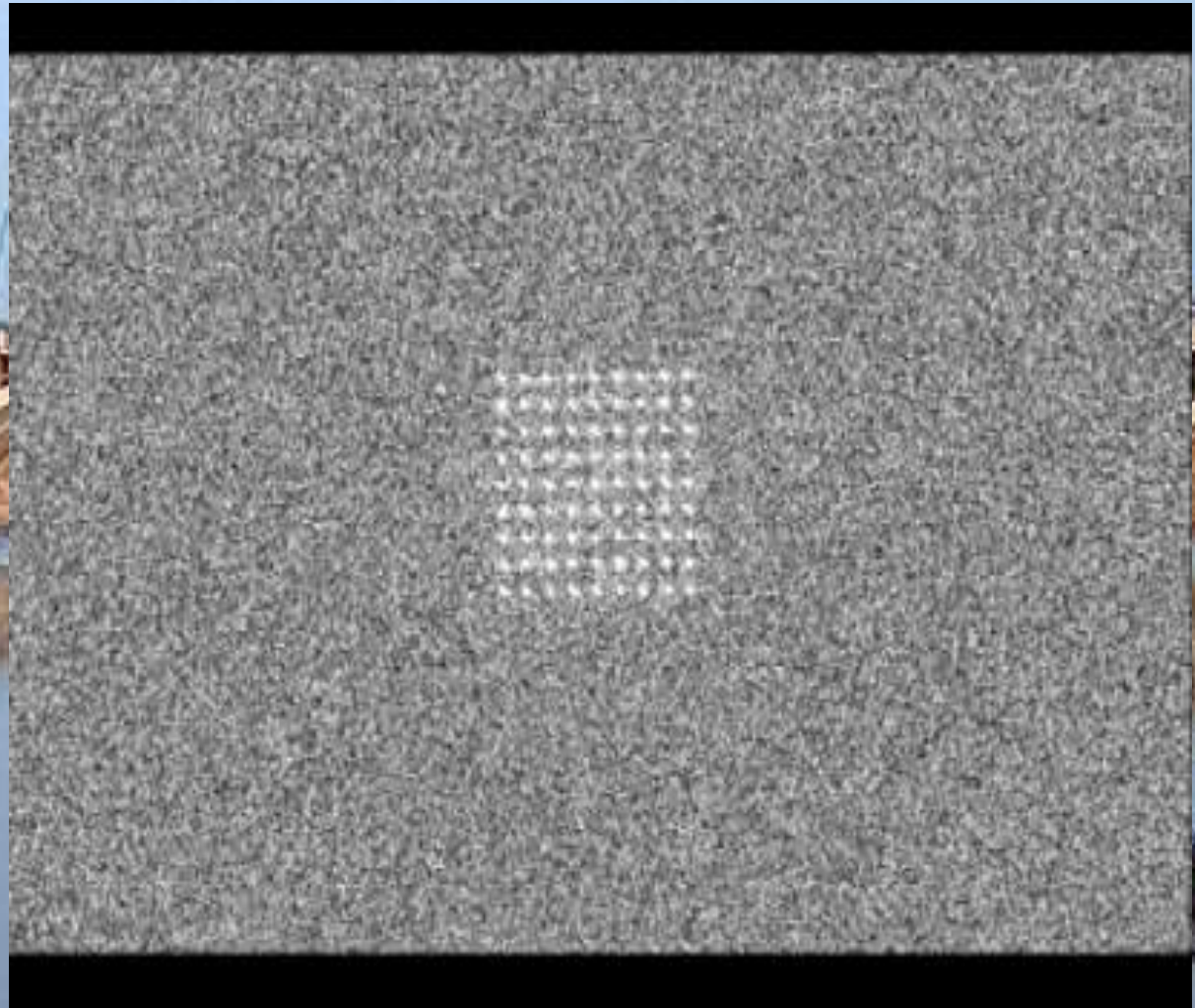
Thunderstorm Alley, TX



2019 EIPBN MicroGraph Contest

54

**Micrograph Title:
Minesweeper in SEM**



When resist is on insulator, coating layer can't help much. Question: do these explosion really occur in the resist, is this a charging artifact, or did I just hit a mine?

Magnification (3"x4"): 40 um > HFW > 8 um

Submitted by: Kerim Arat

Instrument : FEI - Helios NanoLab

Affiliation: Delft University of
Technology

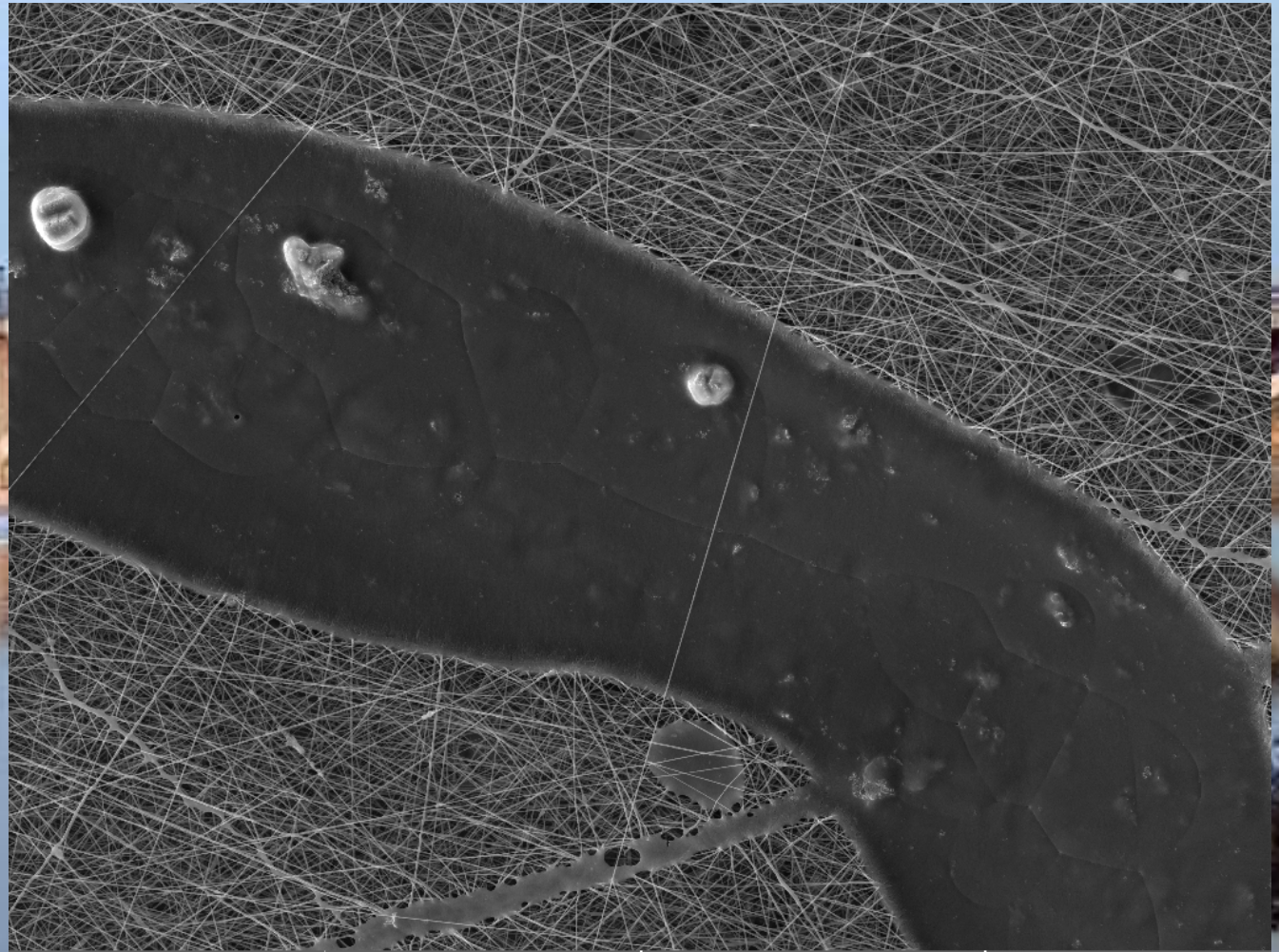


2019 EIPBN MicroGraph Contest

55

Micrograph Title:
A River Runs
Through It

Description:
A large river runs
through a town filled
with roads.



Magnification (3"x4" image): 1.5KX

Submitted by: Lane Huston

Instrument : Tescan MIRA3

Affiliation: Montana Technological Univ.
Butte, Montana

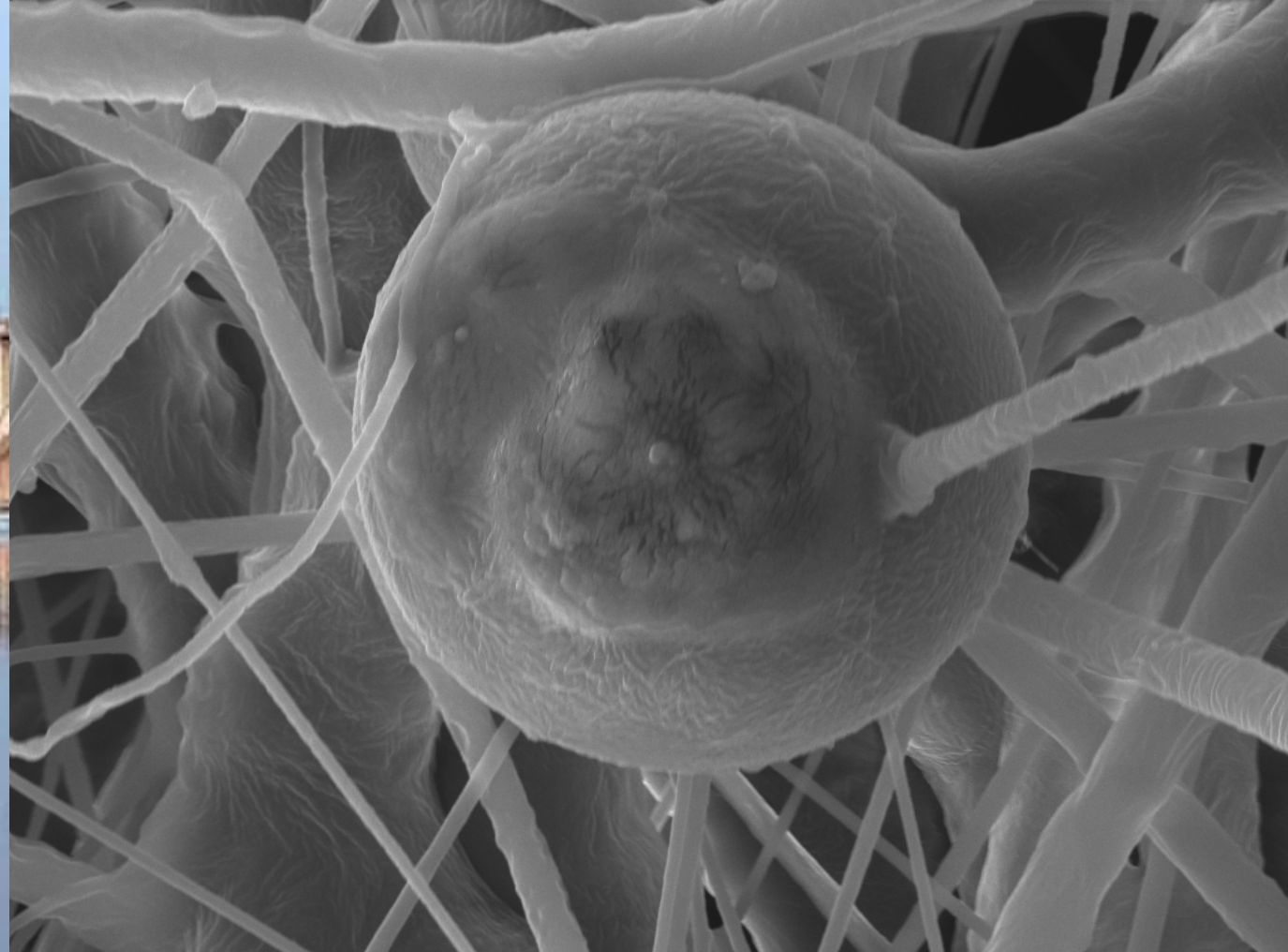


2019 EIPBN MicroGraph Contest

56

Micrograph Title:
Titillating

Description:
We burned a hole
into a polymer bead
to make it look
funny.



Magnification (3"x4" image): 5.89KX

Submitted by: Lane Huston

Instrument : Tescan MIRA3

Affiliation: Montana Technological Univ.
Butte, Montana