



The image is a scanning electron micrograph (SEM) showing several parallel steel pipes. The surface of the pipes is covered with numerous small, white, hair-like structures known as zinc whiskers. Two red lines with arrows indicate a measurement of 17.58 μm across the width of one pipe. A green line with arrows indicates a measurement of 3.01 μm across the width of a whisker. At the bottom right, a scale bar is labeled 20 μm.

Zinc Whiskers on Hot Dip Galvanized Steel Pipe

Compiled by
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From Images and Analysis by
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March 2009

HV	Spot	Mag	Det	Sig	WD	Pressure
15.0 kV	3.0	2680x	Etd	SE	12.17 mm	---

—20 μm—

Background

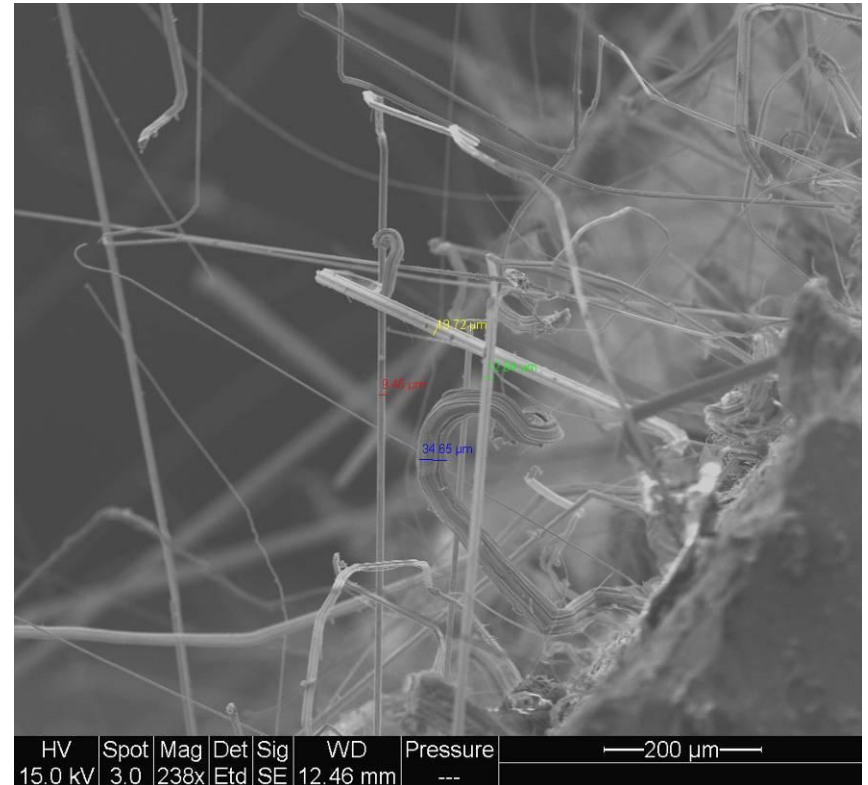
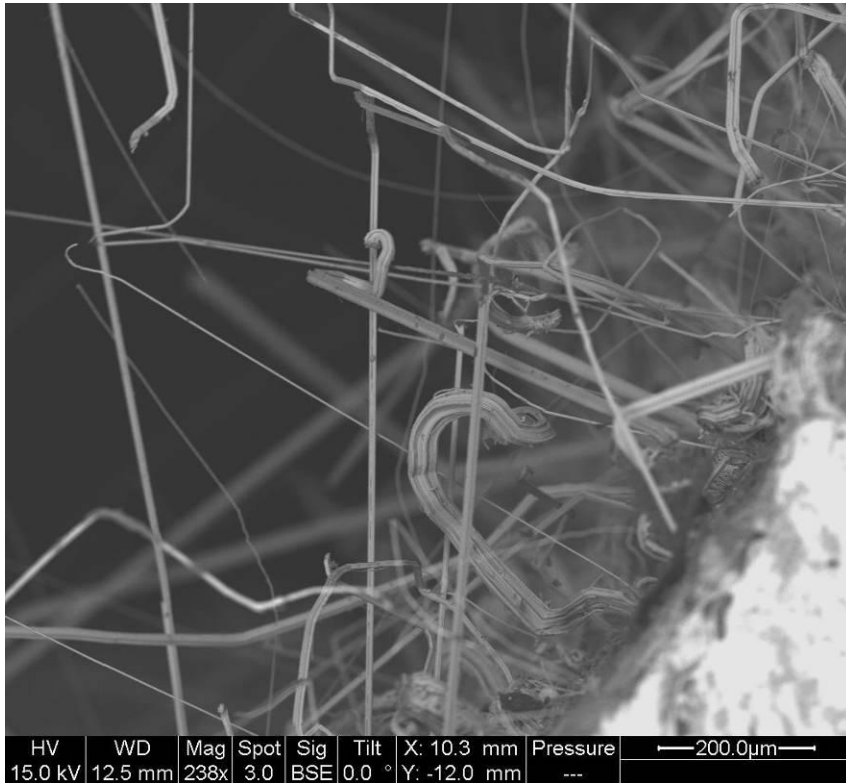
- Hot Dip Galvanized Steel Pipe with Extensive Zinc Whisker Formation
- Provided to Lyudmyla for SEM inspection
 - She documents whisker “diameters” for 17 whiskers
 - Some whisker thicknesses >30 microns for whiskers > 600 microns long!!!



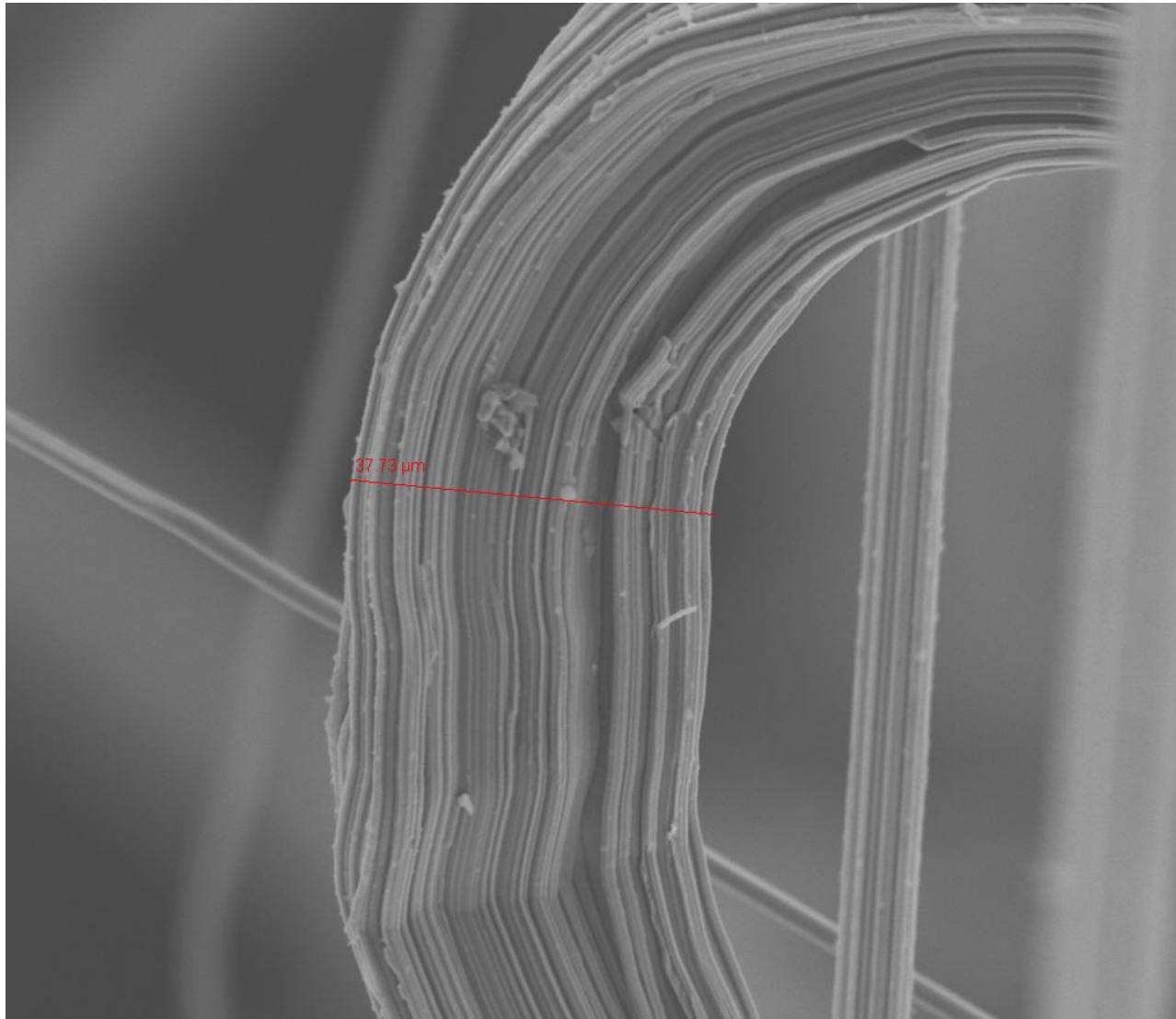
Whisker Geometries for a Few Chosen Examples

File Name	Diameter (um)	Rough Estimated Length (um)
HDGP-area1	37	600
HDGP-area1	19.7	>600
HDGP-area1	9.5	>1600
HDGP-area2-w1	15.8	>1000
HDGP-area2-w2	23.9	500
HDGP-area2-w3	14.6	700
HDGP-area2-w4	4.4	>700
HDGP-area3-w1	3.8	2500
HDGP-area3-w2	9.1	>2000
HDGP-area3-w3	5.5	>1000
HDGP-w1	5.1	>600
HDGP-w2	4.3	>2000
HDGP-w3	6.6	1200
HDGP-w4	17.6	600
HDGP-w4	2	>600
HDGP-w5	12.4	2000
HDGP-w6	3.1	2000
HDGP-w7	8	broken
HDGP-w8	6.5	2200

Zn Whiskers – Area #1

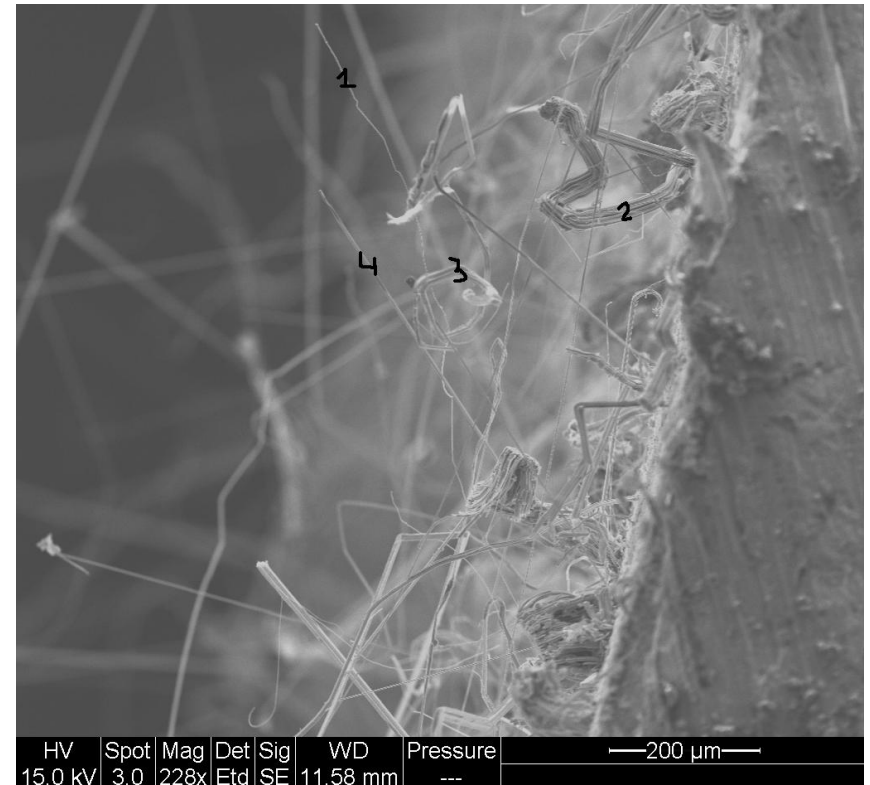
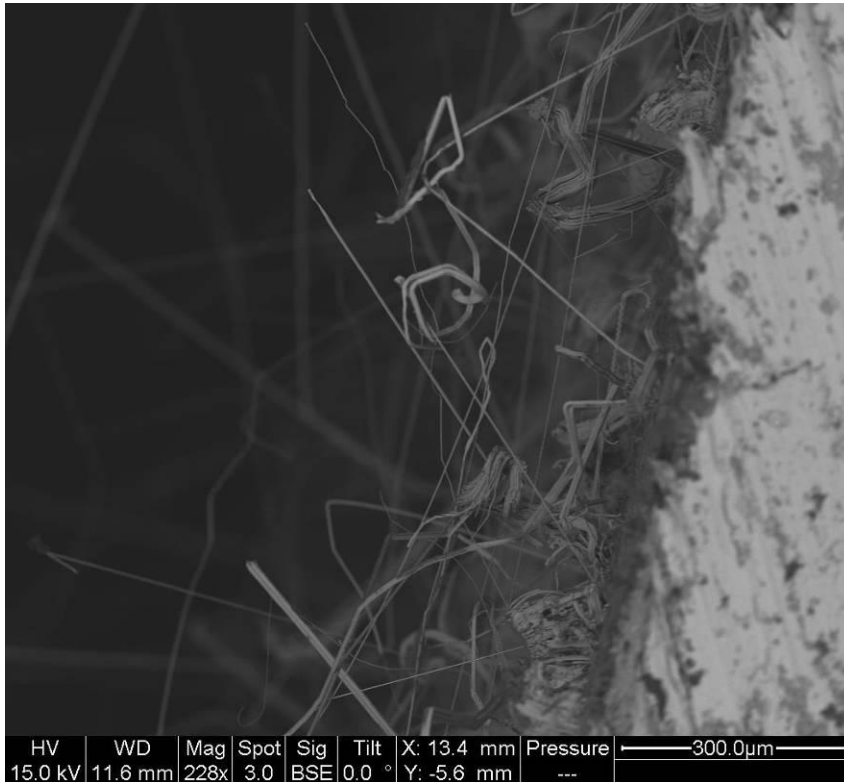


Zn Whiskers – Area #1 Whisker 1



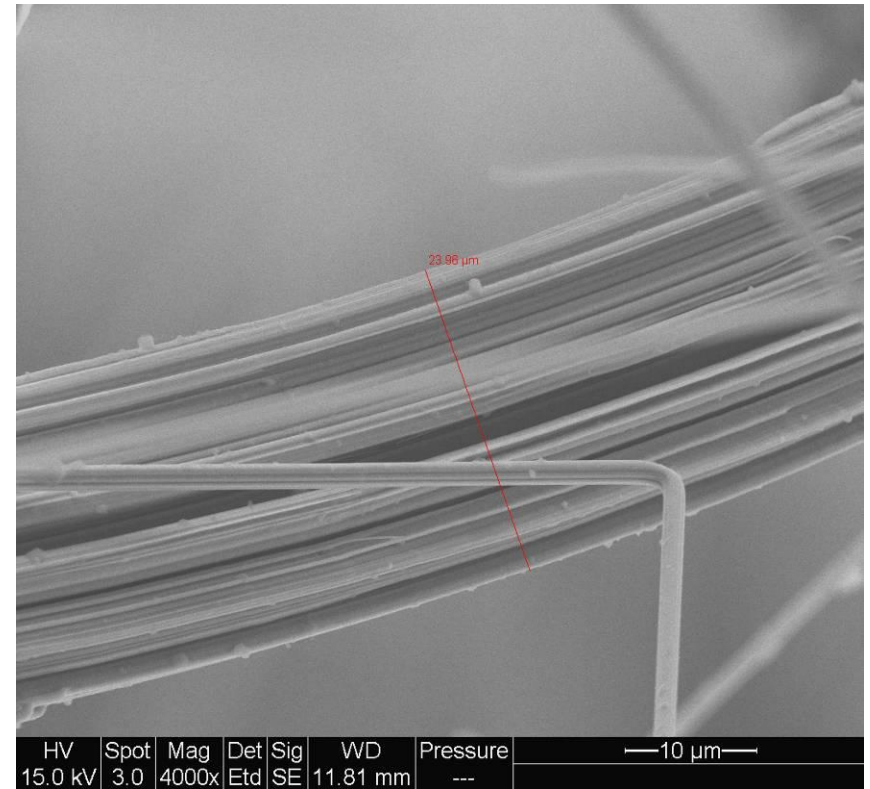
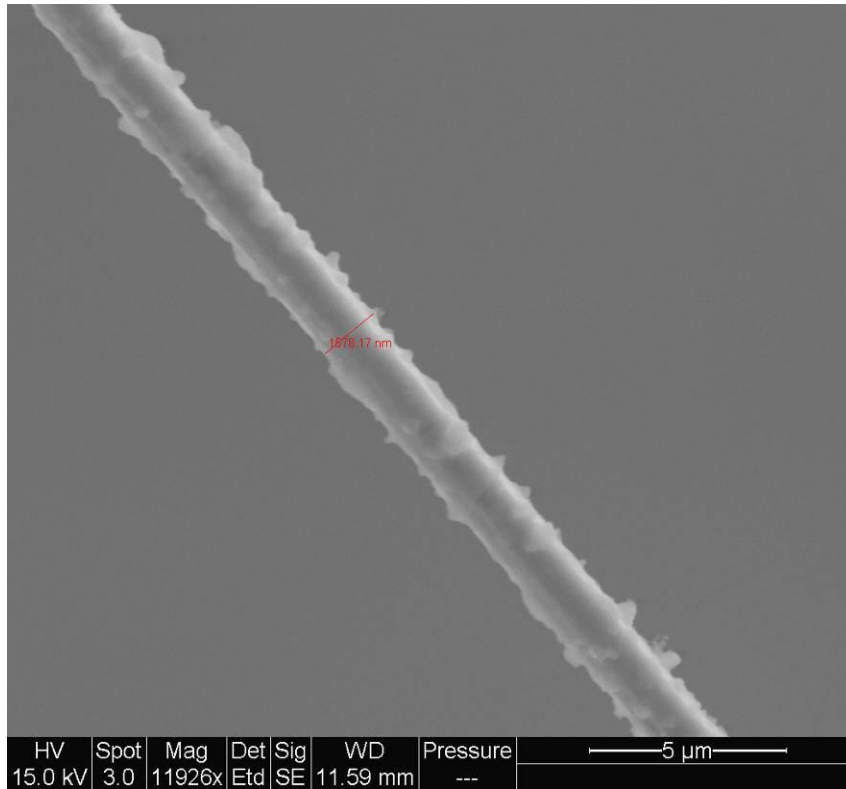
HV	Spot	Mag	Det	Sig	WD	Pressure	—20 μm—
15.0 kV	3.0	2103x	Etd	SE	12.65 mm	---	

Zn Whiskers – Area #2



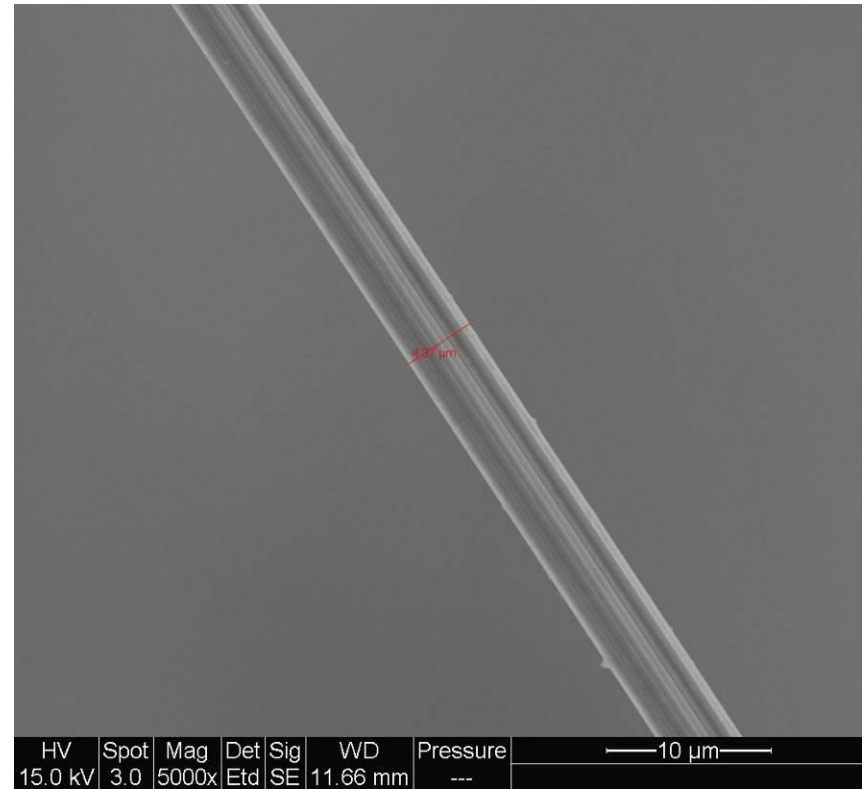
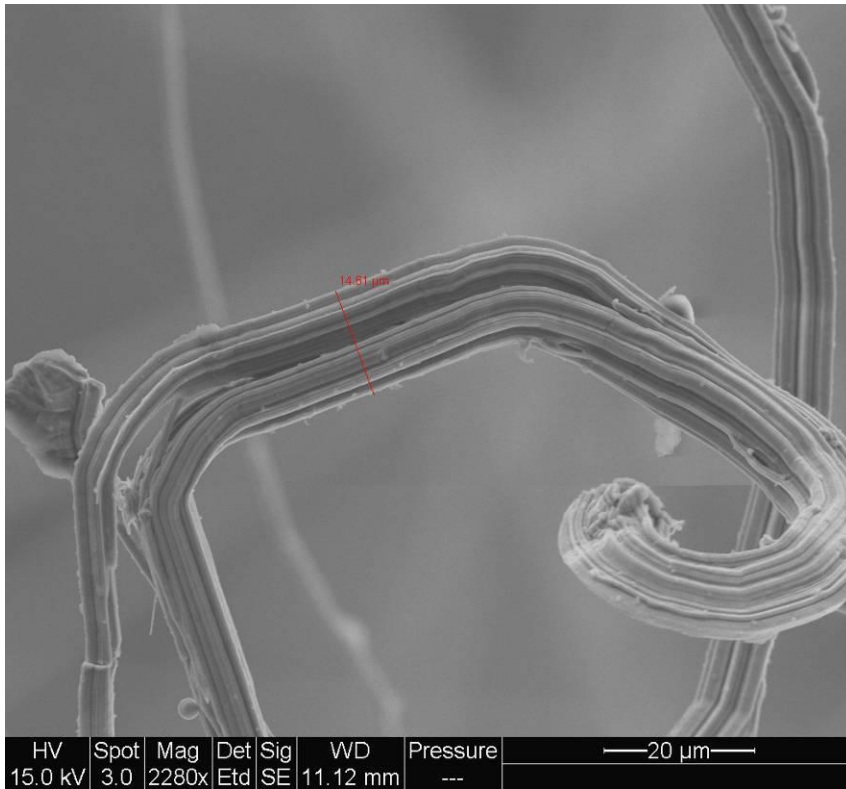
Zn Whiskers – Area #2

Whisker 1 and 2

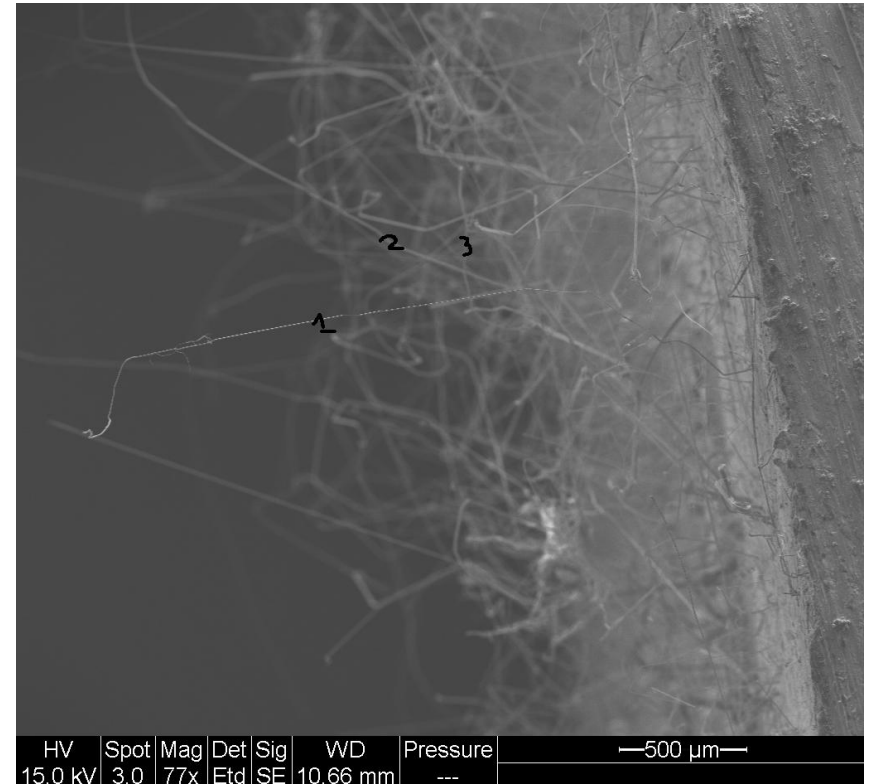
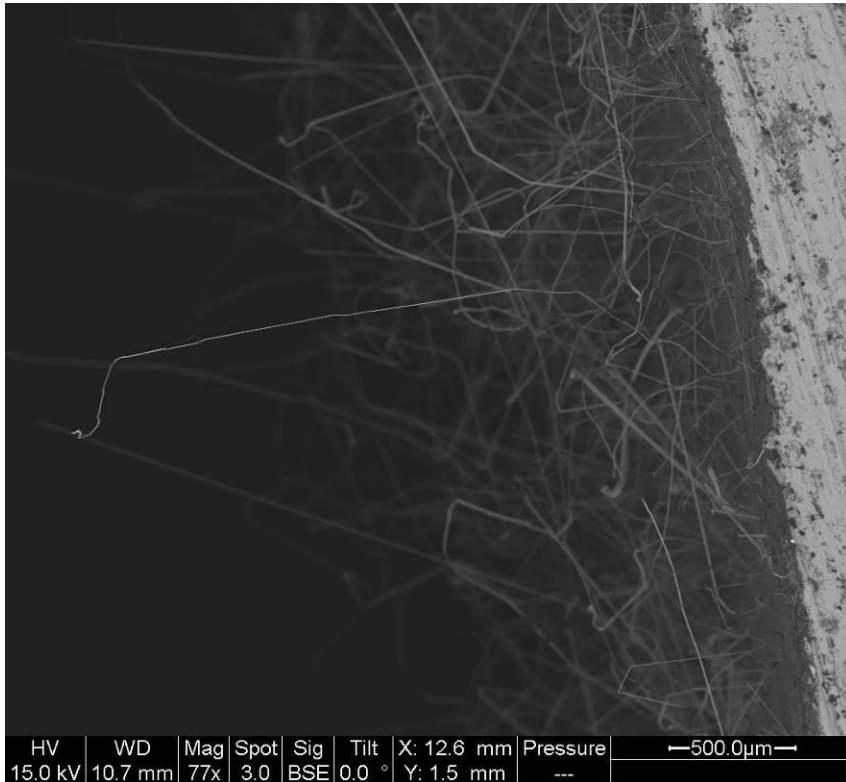


Zn Whiskers – Area #2

Whisker 3 and 4

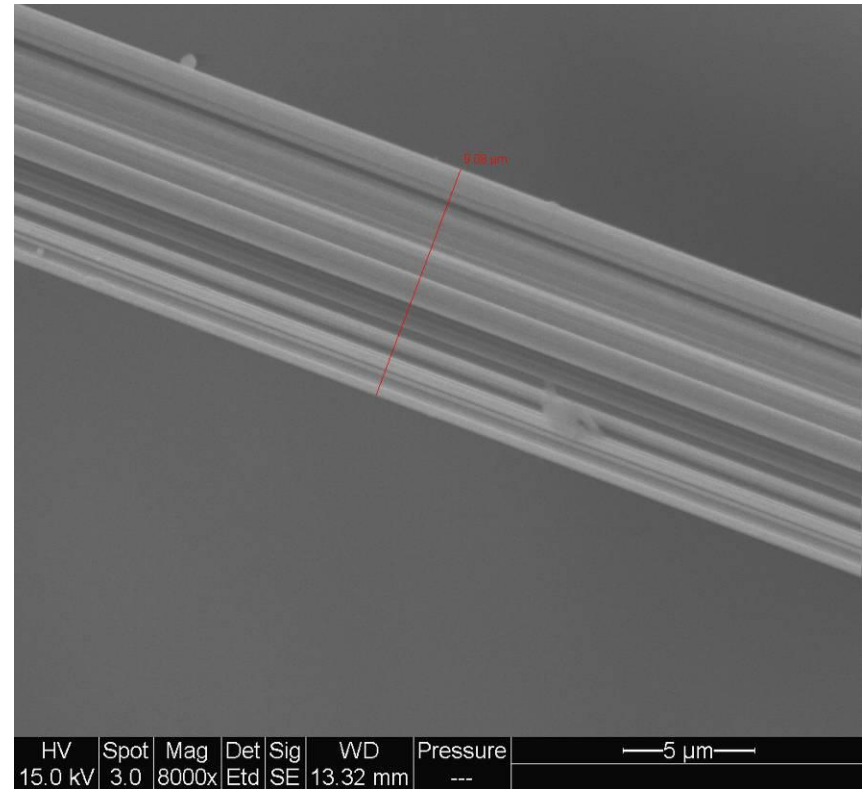
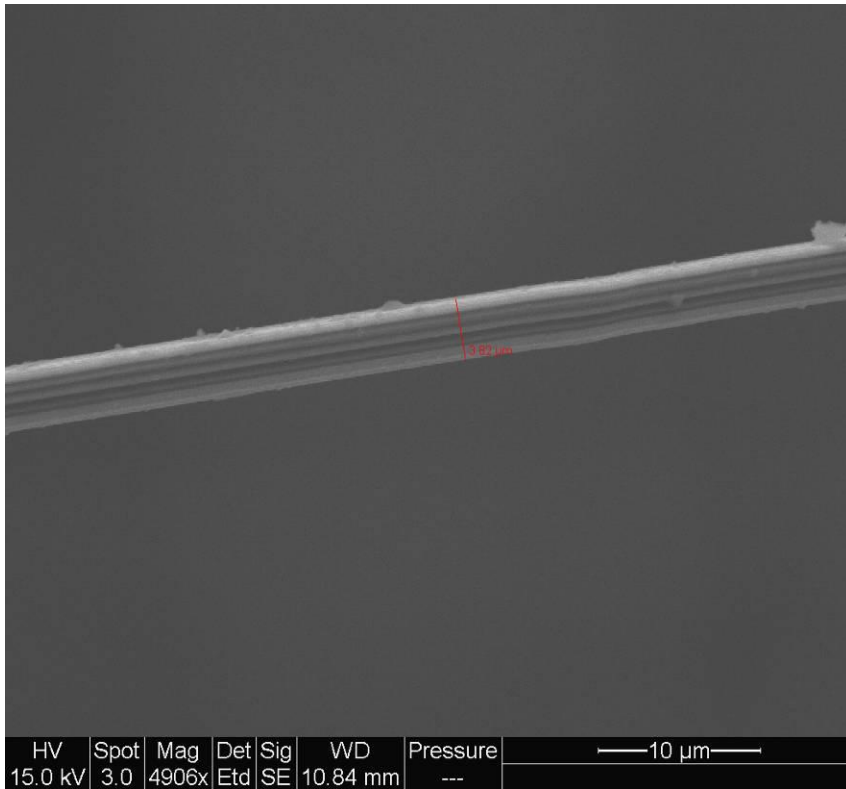


Zn Whiskers – Area #3



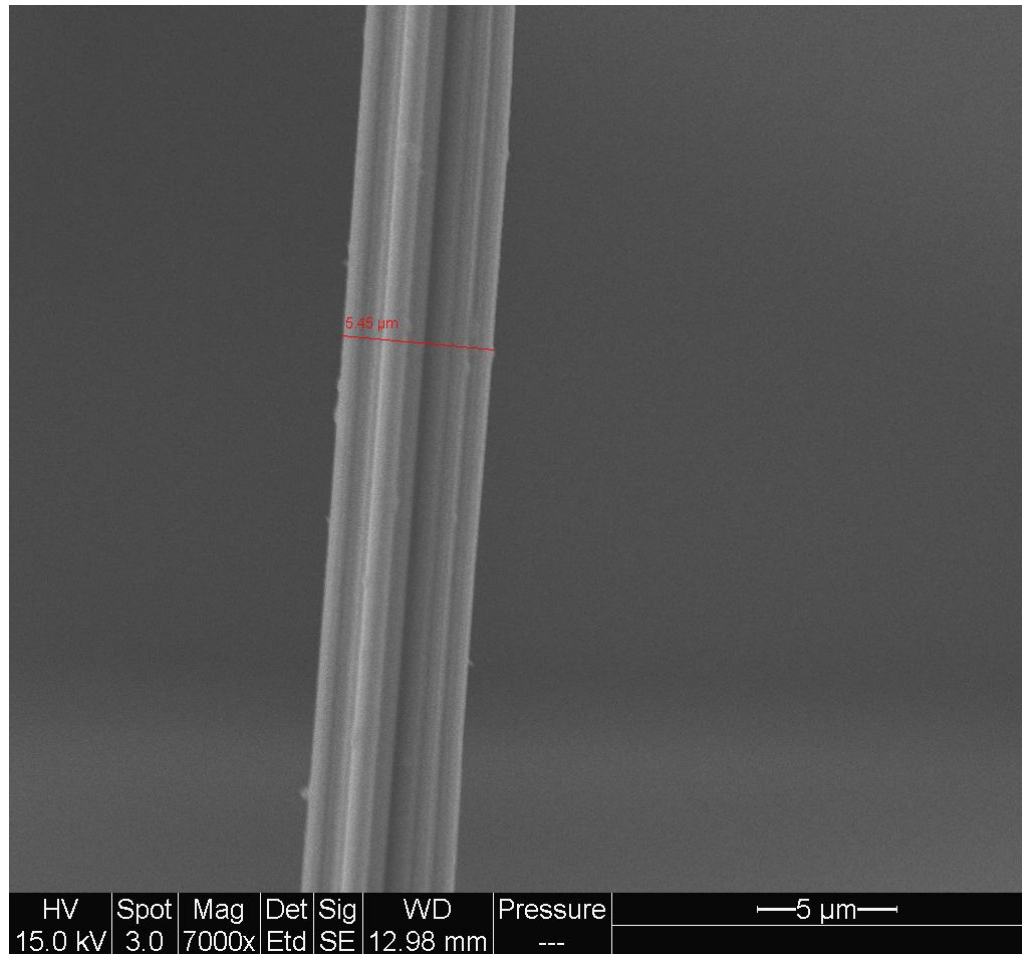
Zn Whiskers – Area #3

Whisker 1 and 2



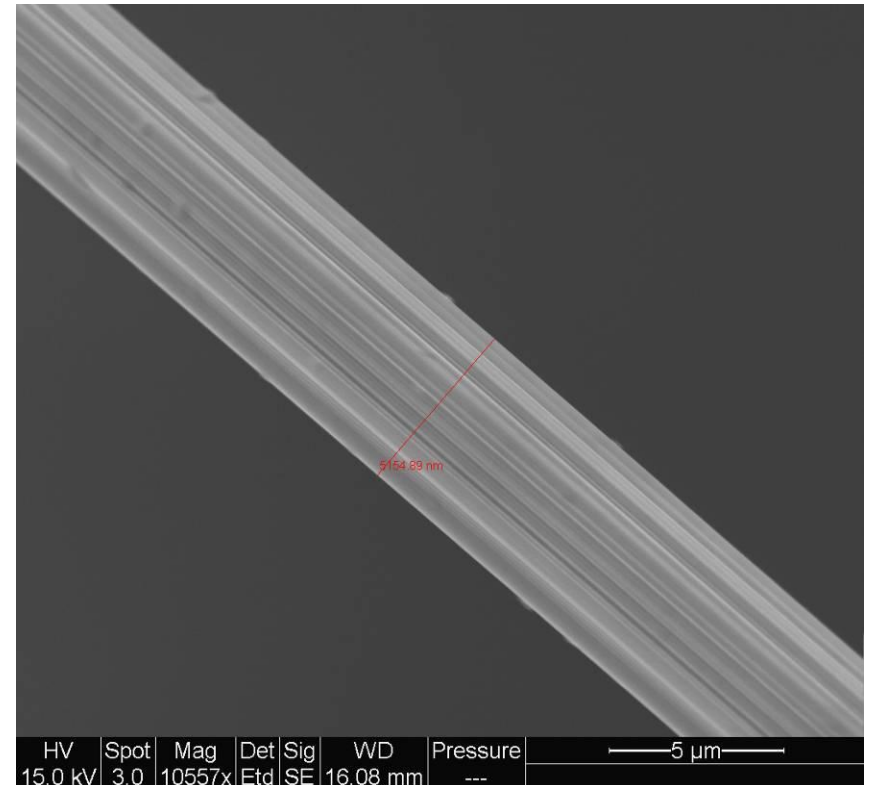
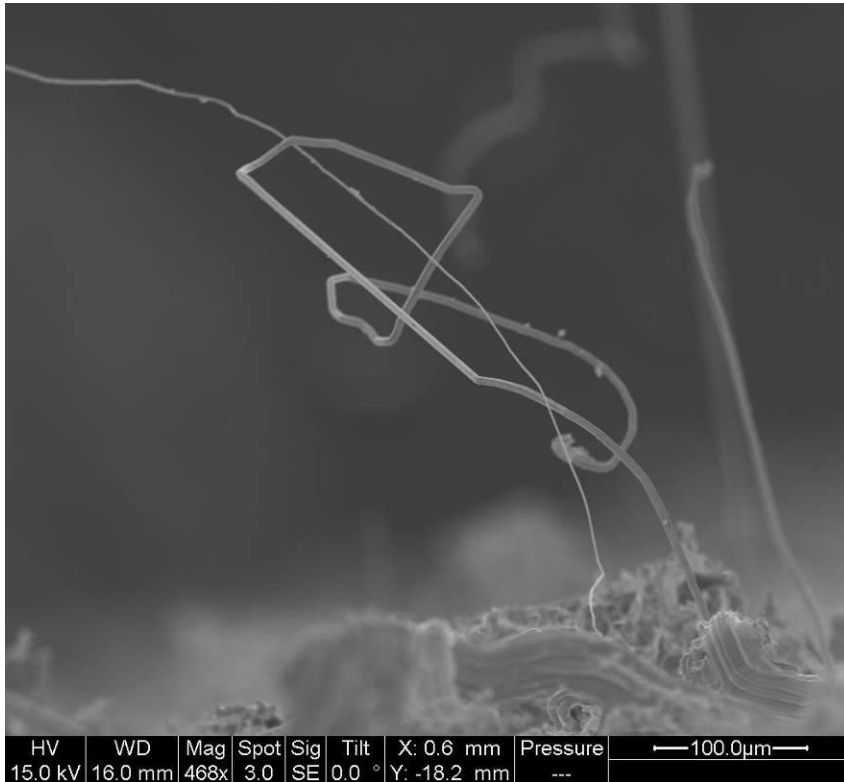
Zn Whiskers – Area #3

Whisker 3



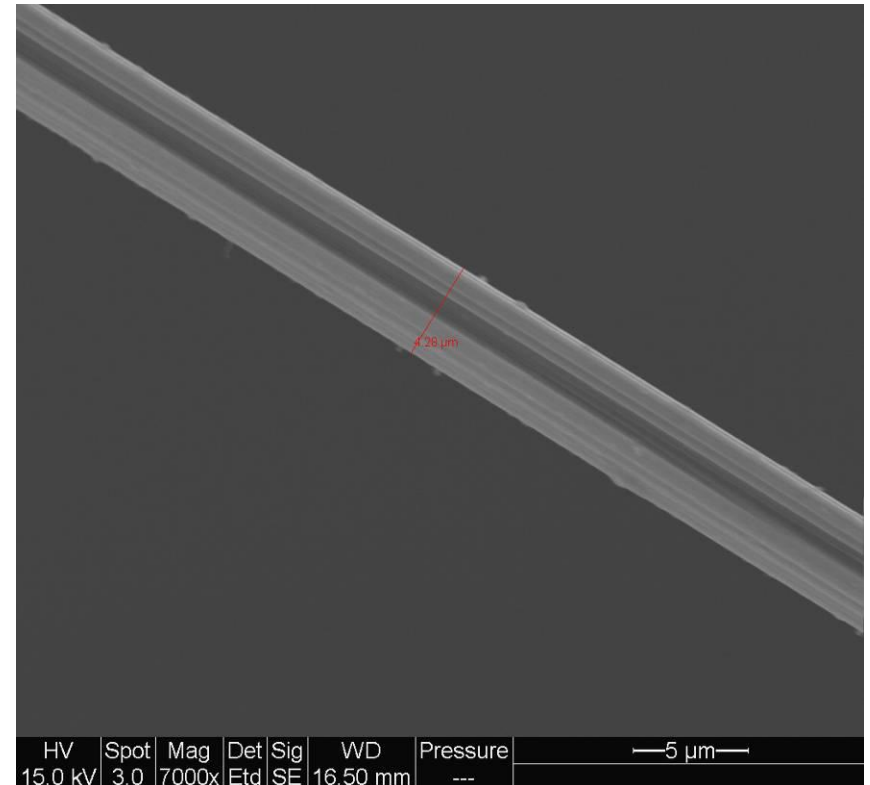
Zn Whiskers – Area HDGP

Whisker 1



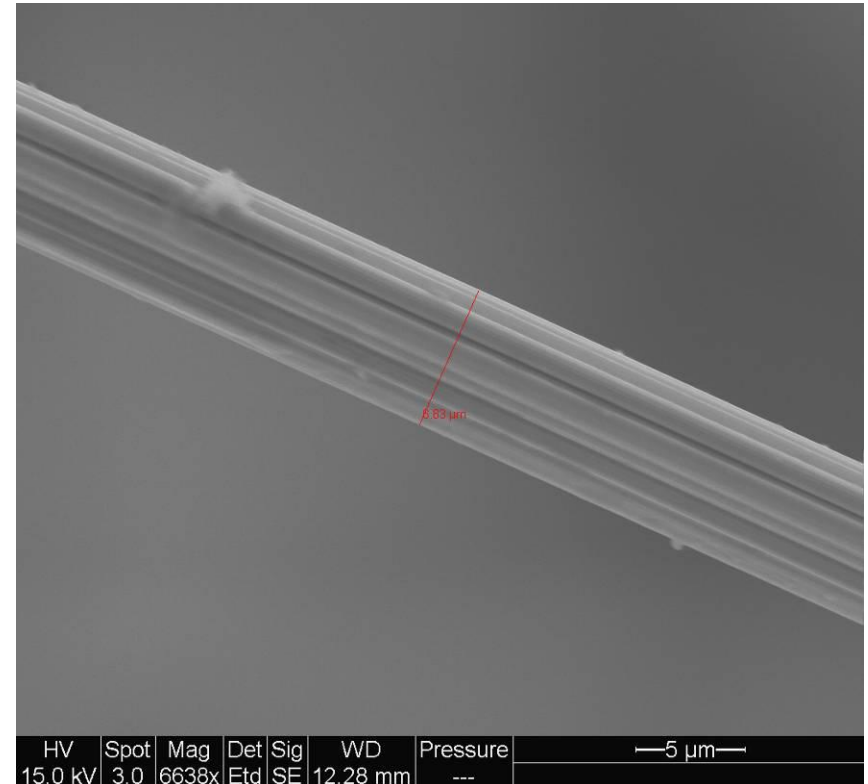
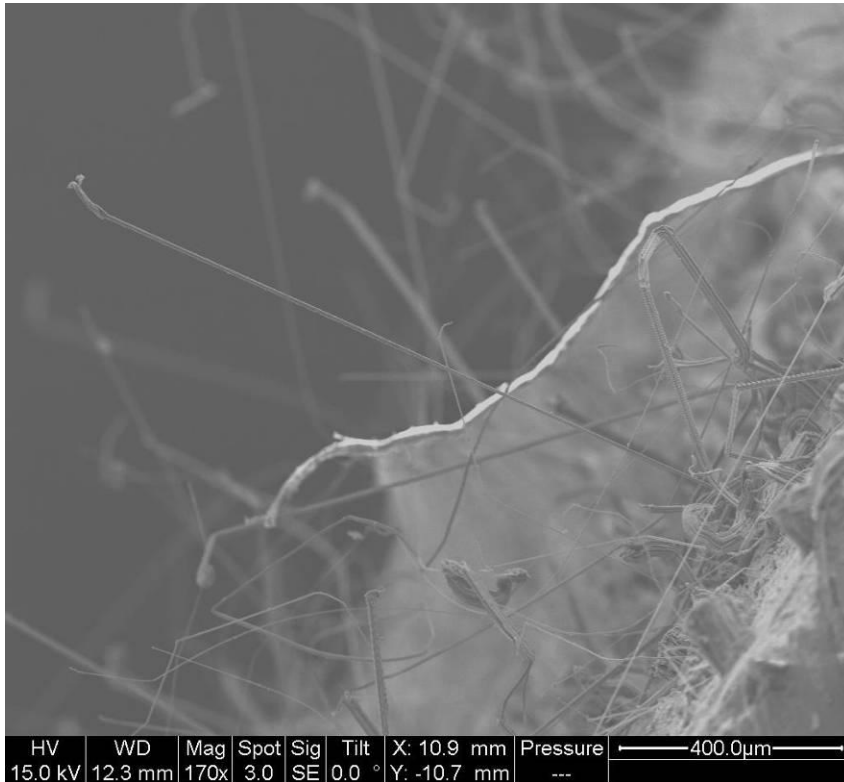
Zn Whiskers – Area HDGP

Whisker 2



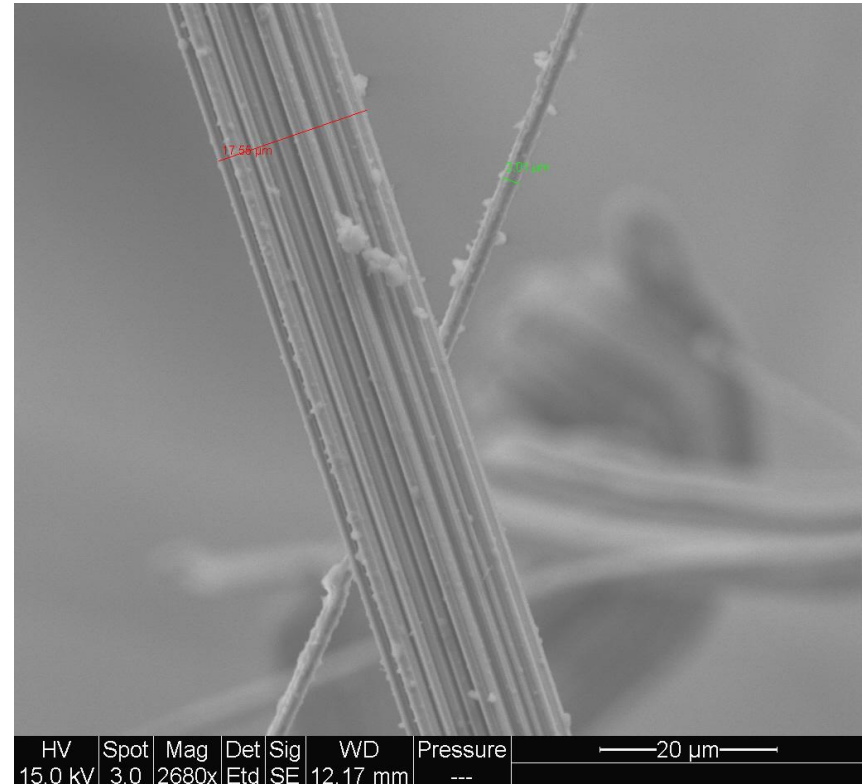
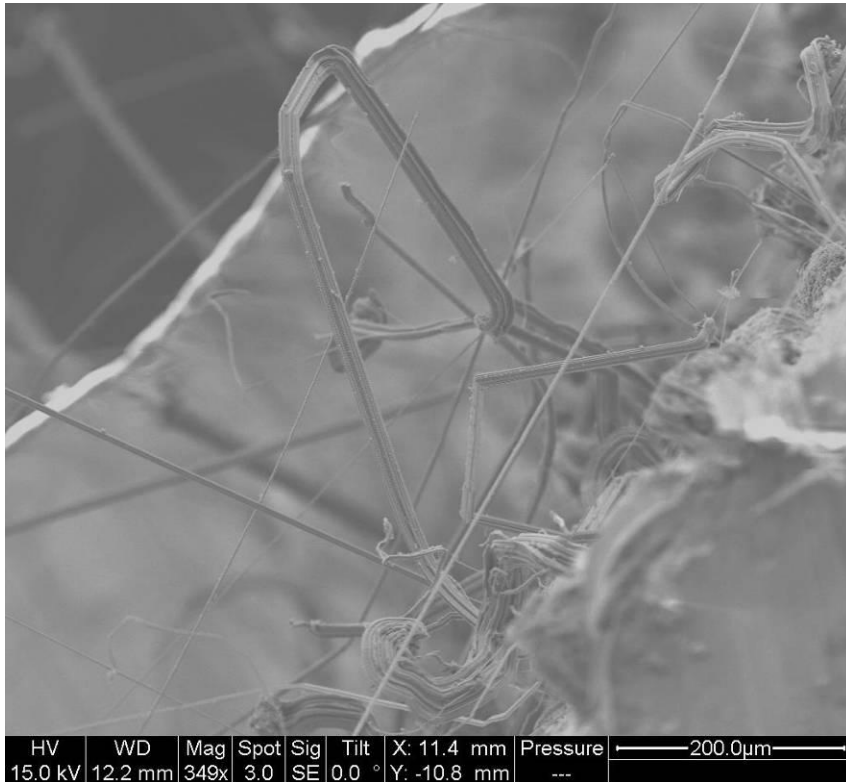
Zn Whiskers – Area HDGP

Whisker 3



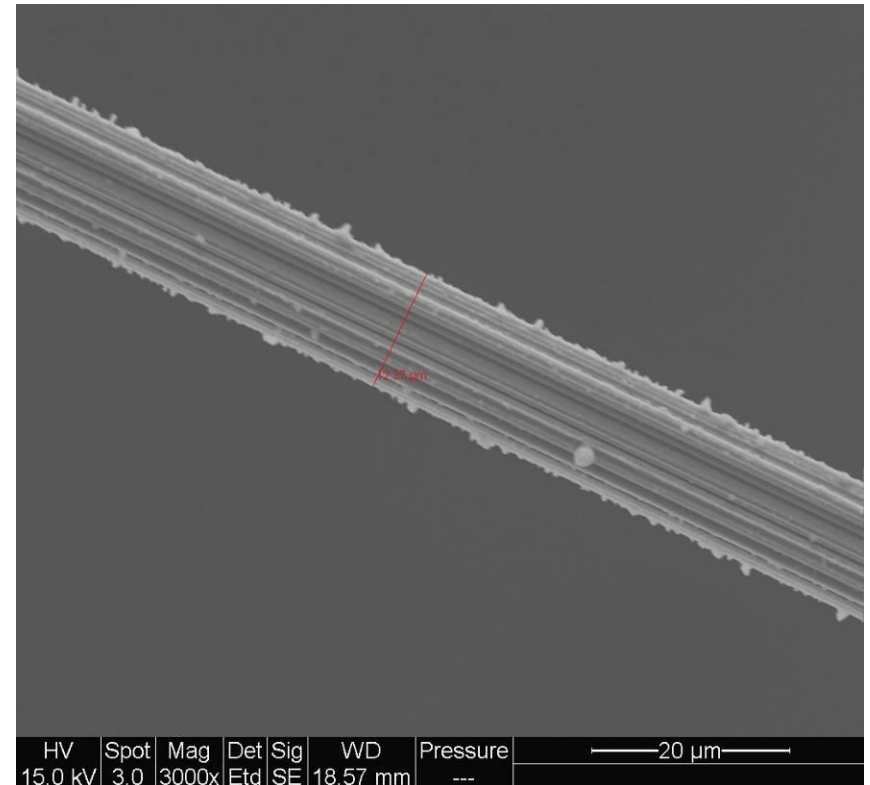
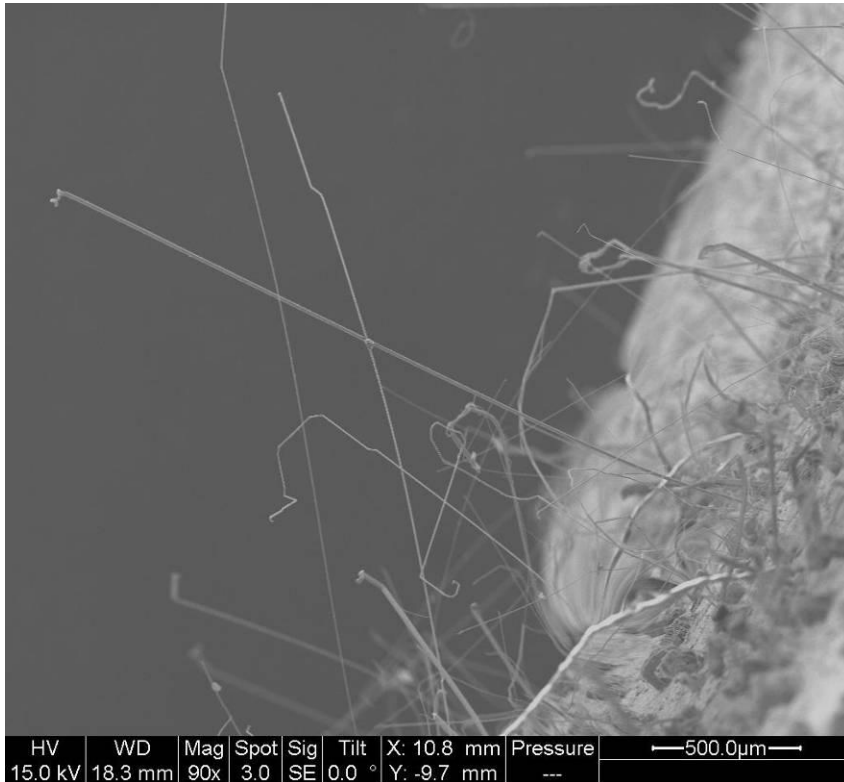
Zn Whiskers – Area HDGP

Whisker 4



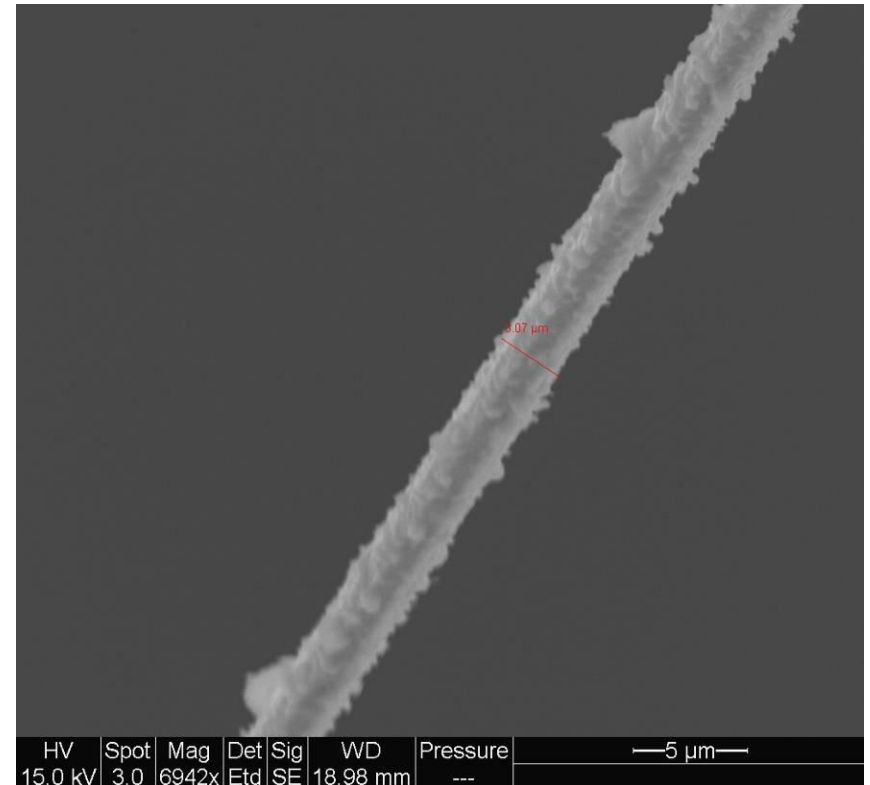
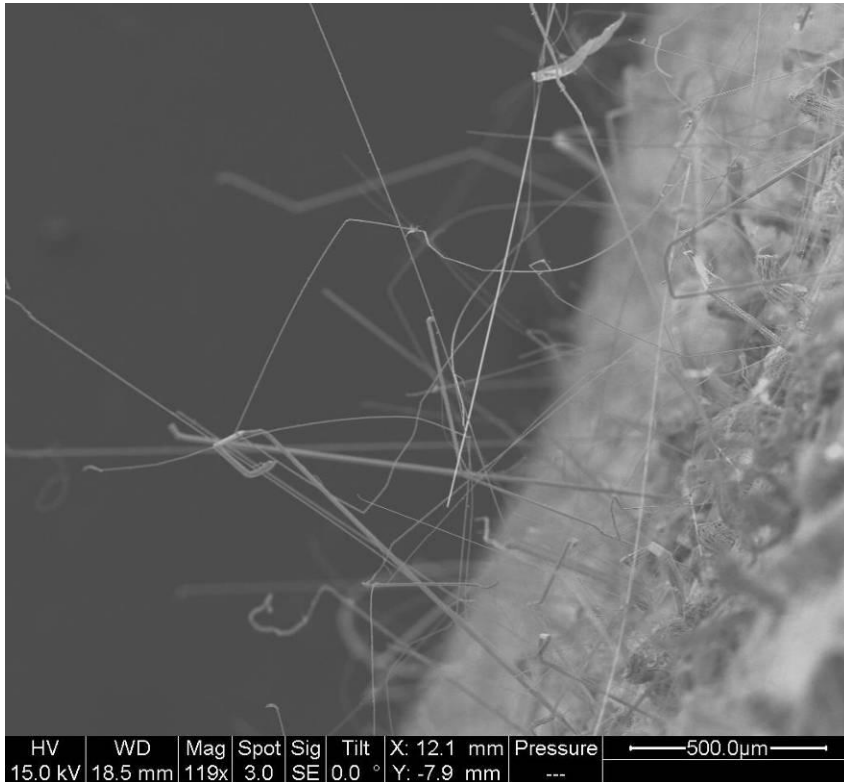
Zn Whiskers – Area HDGP

Whisker 5



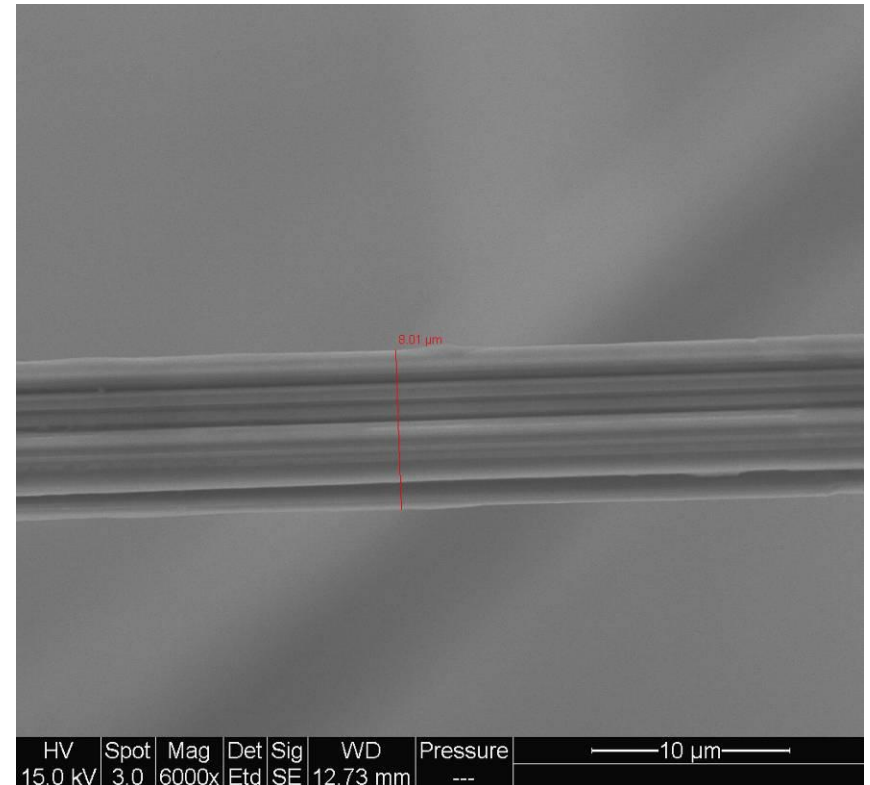
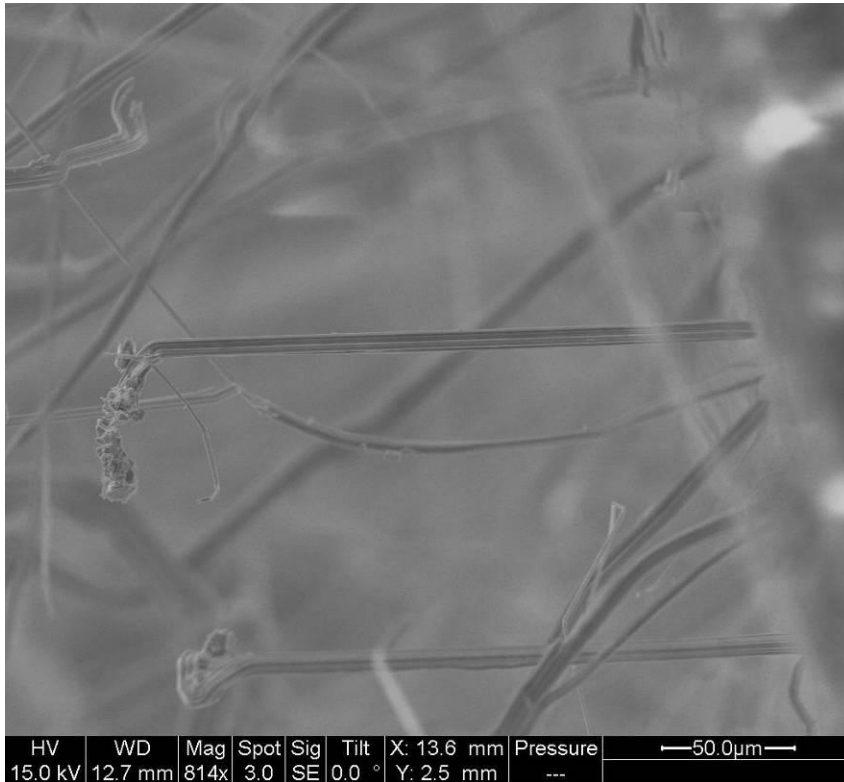
Zn Whiskers – Area HDGP

Whisker 6



Zn Whiskers – Area HDGP

Whisker 7



Zn Whiskers – Area HDGP

Whisker 8

