



Subject: Laboratory Report # OEM138-002
Submitter: Omar Al Taher, Johanson Dielectrics, Inc.
Description: Tin Whisker Qualification by
Temperature Humidity Stress,
Part # 160S41W475KV4 100% Sn
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Jeff Shearer
SEM Laboratory Manager
(610) 939-9500 x-37
e-mail jshearer@siliconcert.com

4201 Pottsville Pike, Bldg. 4A
Reading, PA 19605
Fax (610) 939-1010

Problem:

Capacitors from four groups were evaluated for tin whisker growth as per iNEMI recommendations. The units were examined 'as received' and after 1000 hours and 4000 hours of temperature humidity stress. The units were stressed at 60C /93%RH for 4000 hours. The devices were inspected as per JEDEC standard JESD22A121.

The plating group contained in this report is: **160S41W475KV4 lot #514-5389 100% Sn**

Summary:

- Nine capacitors with a total of 18 terminations were scanned for the presence of whiskers pre- and post-temperature humidity stress. The capacitors were labeled '1' through '9'. The terminations on each capacitor were labeled 'left' and 'right'.
- Representative images were made for each 'as received' capacitor termination at magnifications of 250x and 2500x to show the general plating structure (fig. 1 - 36).
- **Note:** The whisker length reported is the total axial whisker length as per JEDEC std. JESD22A121 definition 3.1. Also only whiskers of 10um or greater in length should be classified as 'true' whiskers as per JEDEC std. JESD22A121 definition 3.2. Growths less than 10um are included in the listing for reference purposes.
- No whiskers were observed 'as received' (pre-temperature humidity stress) on any of the 18 terminations.
- Representative images were made of the capacitor terminations after 1000 hours (fig. 37 - 55) and 4000 hours (fig. 56 - 84) stress at magnifications of 250x and 2500x to document a) the longest tin whiskers, if present, b) the representative surface structure, or c) non-whisker solder 'anomalies'.
- Capacitor 1, right side (fig. 58,59) after 4000 hours showed one possible whisker, 1um in length. This may be classified as a non-reportable 'pre-' whisker since it is less than 10um in length.
- Non-whisker solder oxidation anomalies were observed on several capacitors (example - capacitor #4, left side, fig 66, 67).

Conclusion:

- As per JEDEC std. JESD22A121 definitions, no tin whiskers were observed on the nine stressed, **160S41W475KV4 lot #514-5389 100% Sn**, capacitors after 4000 hours at 60C/93%RH.

160S41W475KV4 – pre Temp Humidity

Fig. 1

250x magnification

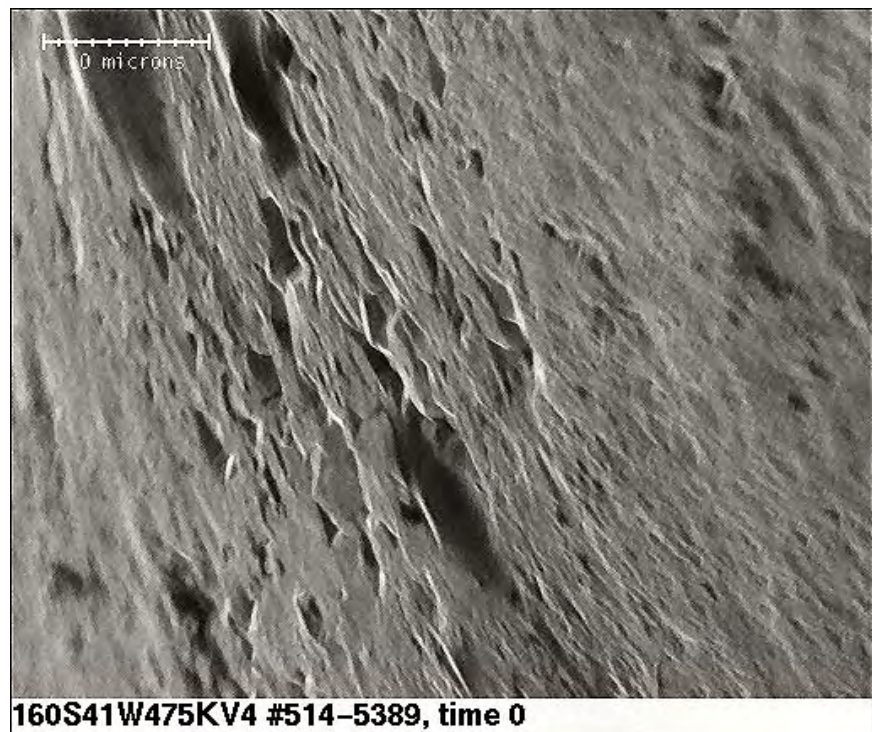
Sample 1 - left



Fig. 2

2500x magnification

Sample 1 - left



160S41W475KV4 – pre Temp Humidity

Fig. 3

250x magnification

Sample 1 - right

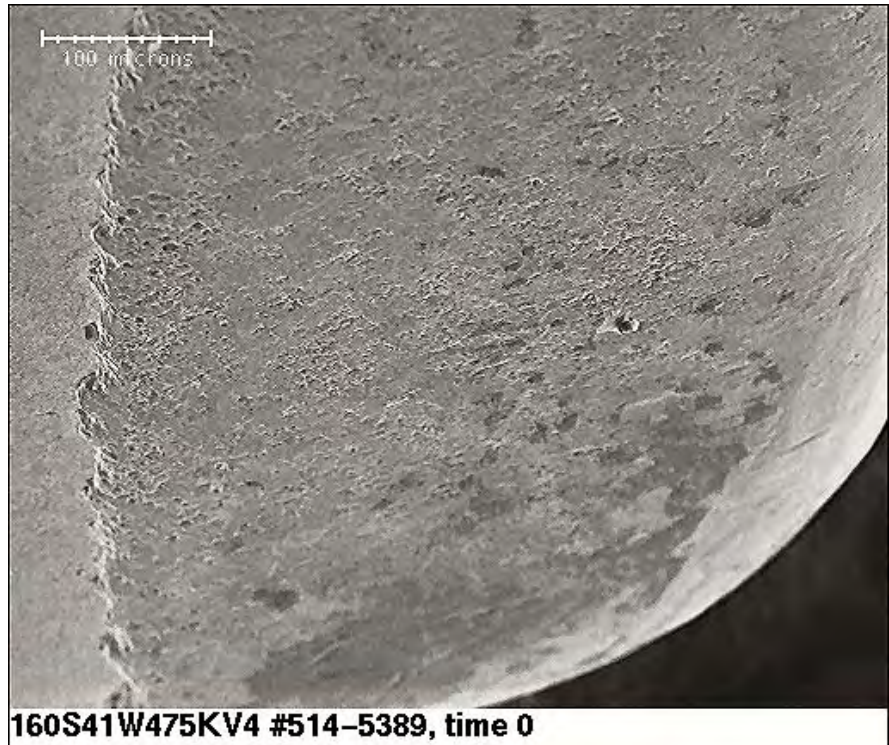
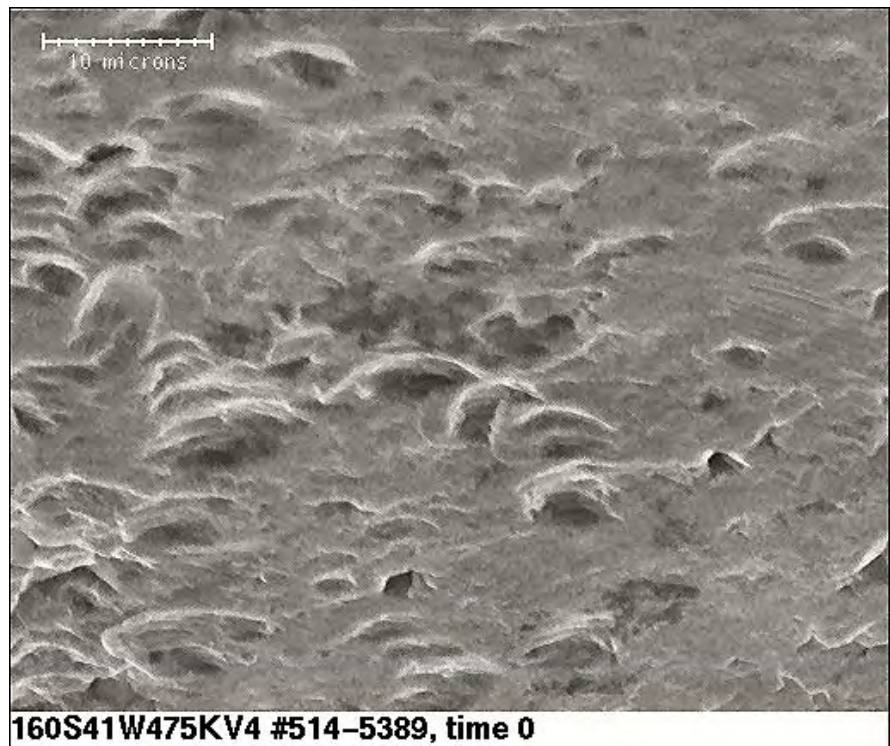


Fig. 4

2500x magnification

Sample 1 - right



160S41W475KV4 – pre Temp Humidity

Fig. 5

250x magnification

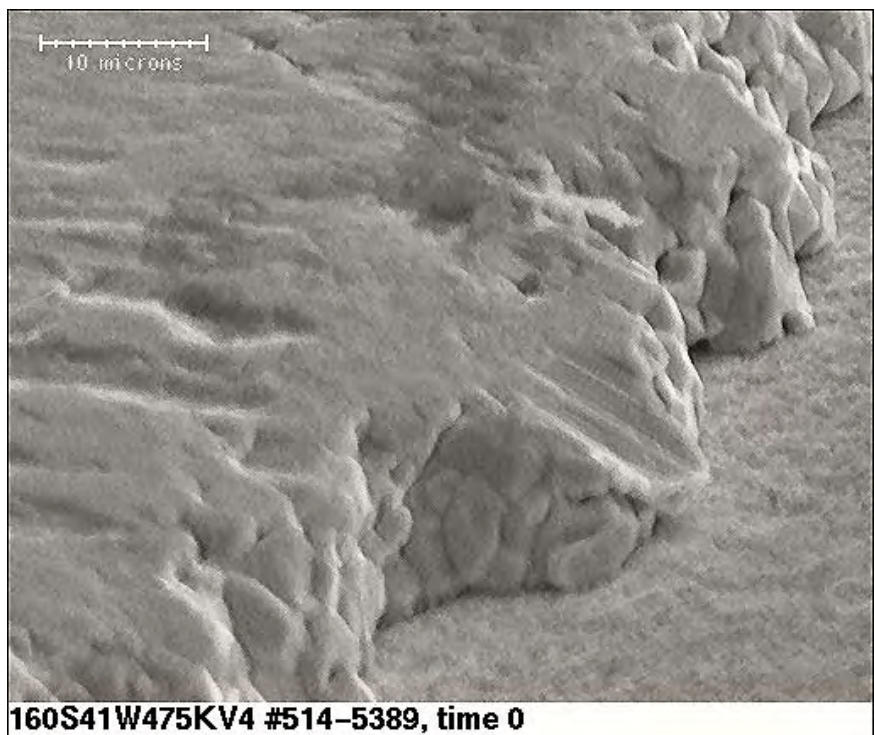
Sample 2 - left



Fig. 6

2500x magnification

Sample 2 - left



160S41W475KV4 – pre Temp Humidity

Fig. 7

250x magnification

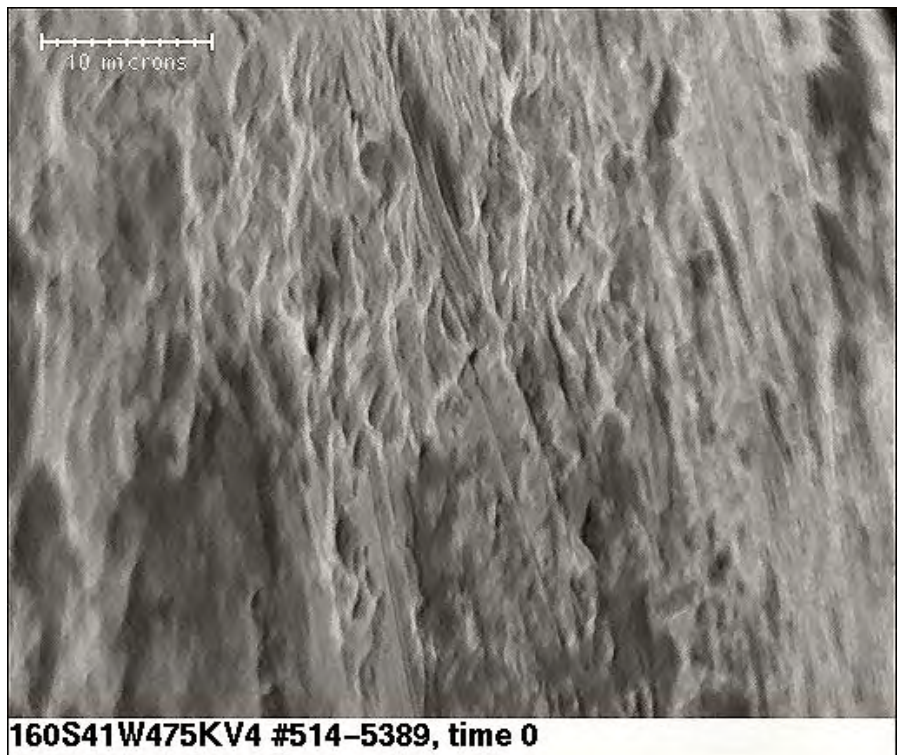
Sample 2 - right



Fig. 8

2500x magnification

Sample 2 - right



160S41W475KV4 – pre Temp Humidity

Fig. 9

250x magnification

Sample 3 - left

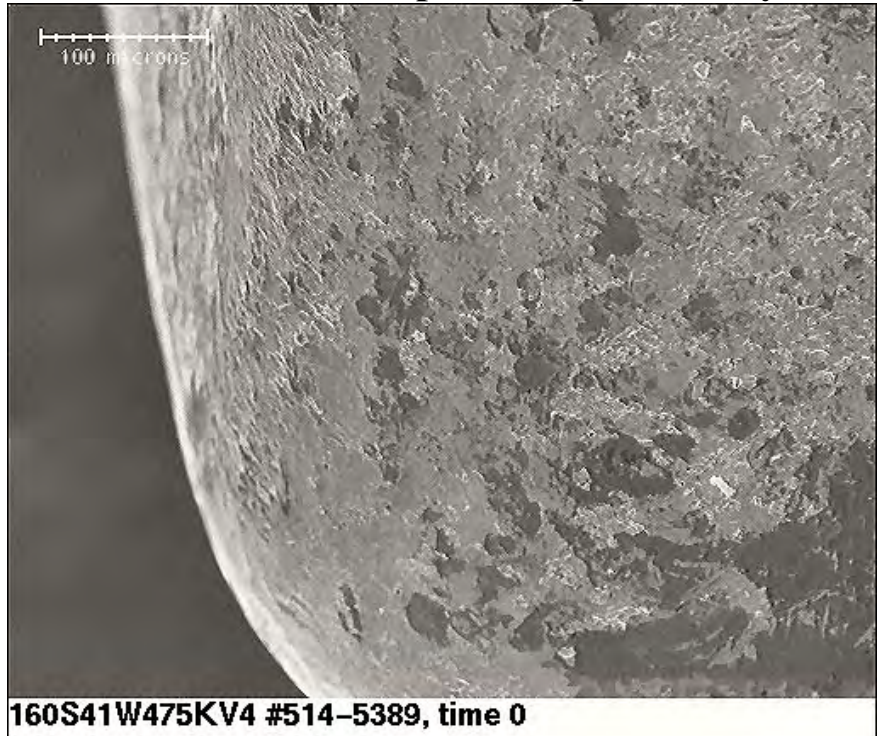


Fig. 10

2500x magnification

Sample 3 - left



160S41W475KV4 – pre Temp Humidity

Fig. 11

250x magnification

Sample 3 - right

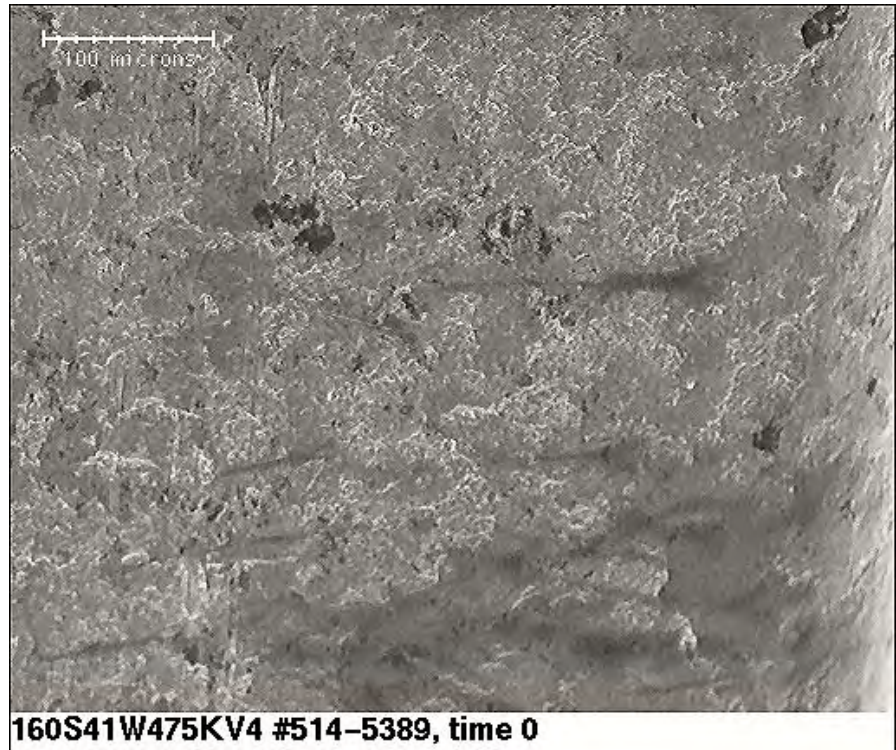
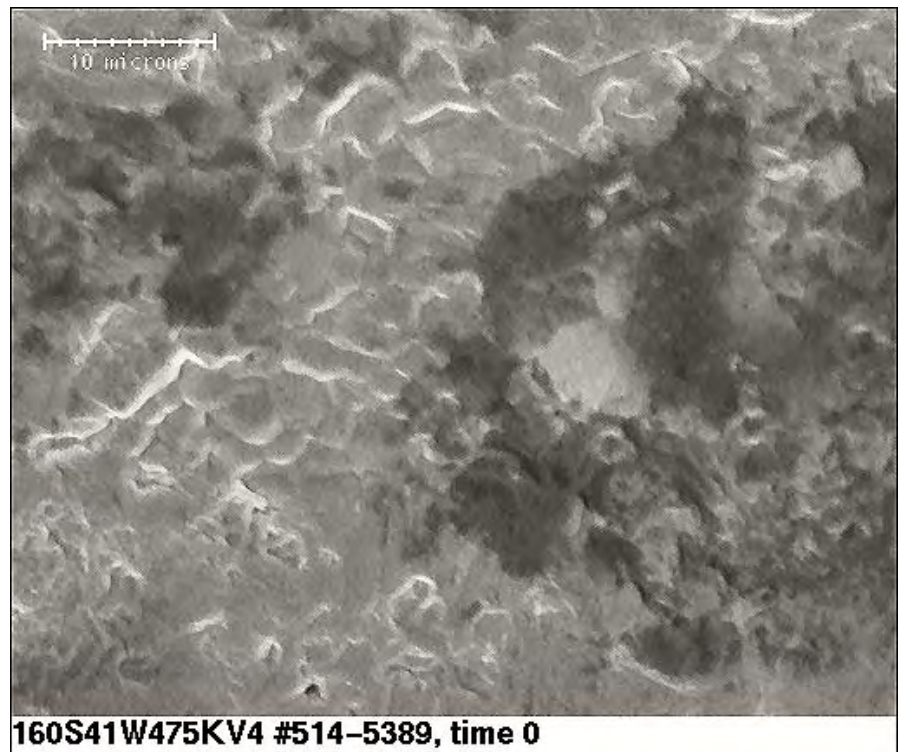


Fig. 12

2500x magnification

Sample 3 - right



160S41W475KV4 – pre Temp Humidity

Fig. 13

250x magnification

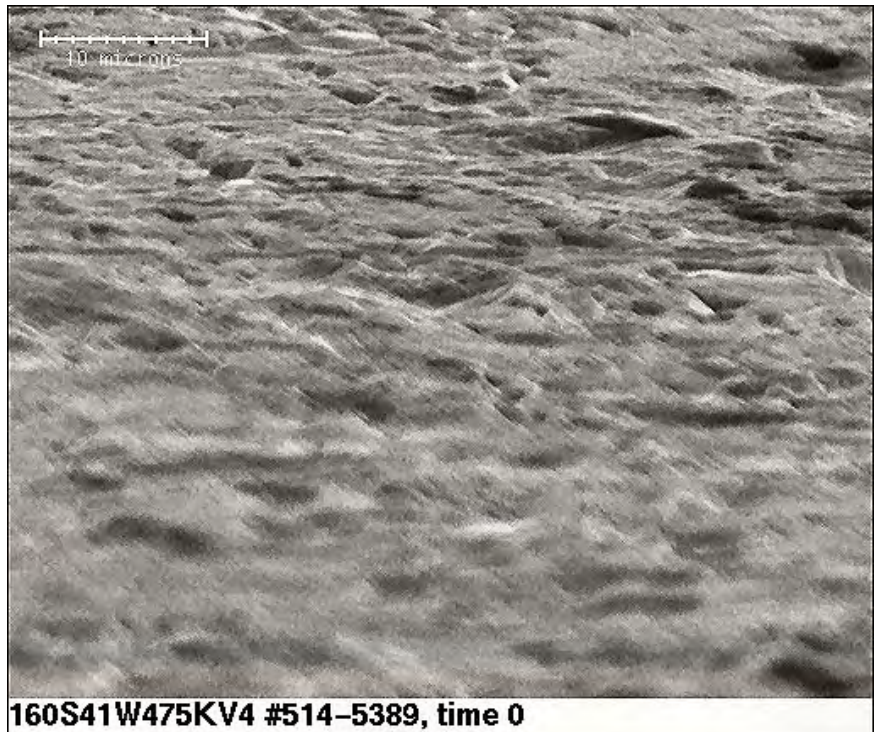
Sample 4 - left



Fig. 14

2500x magnification

Sample 4 - left



160S41W475KV4 – pre Temp Humidity

Fig. 15

250x magnification

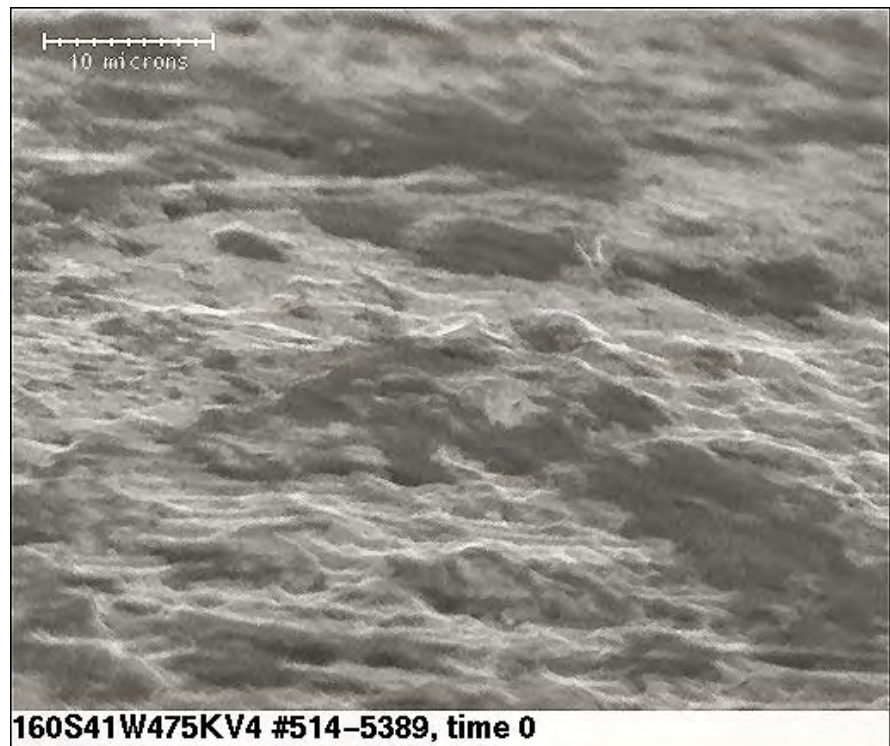
Sample 4 - right



Fig. 16

2500x magnification

Sample 4 - right



160S41W475KV4 – pre Temp Humidity

Fig. 17

250x magnification

Sample 5 - left

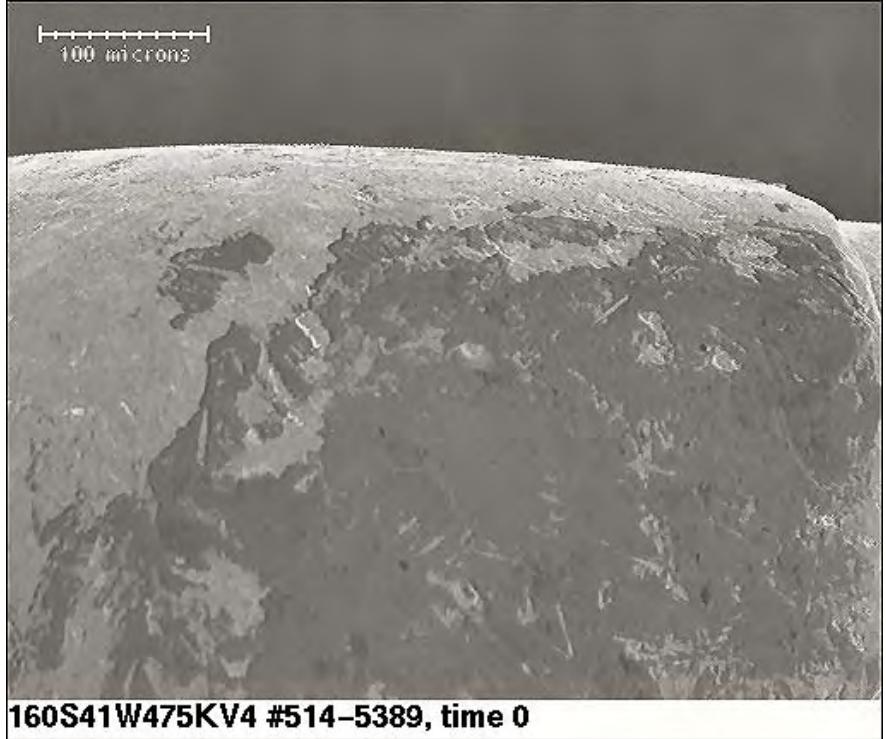


Fig. 18

2500x magnification

Sample 5 - left



160S41W475KV4 – pre Temp Humidity

Fig. 19

250x magnification

Sample 5 - right

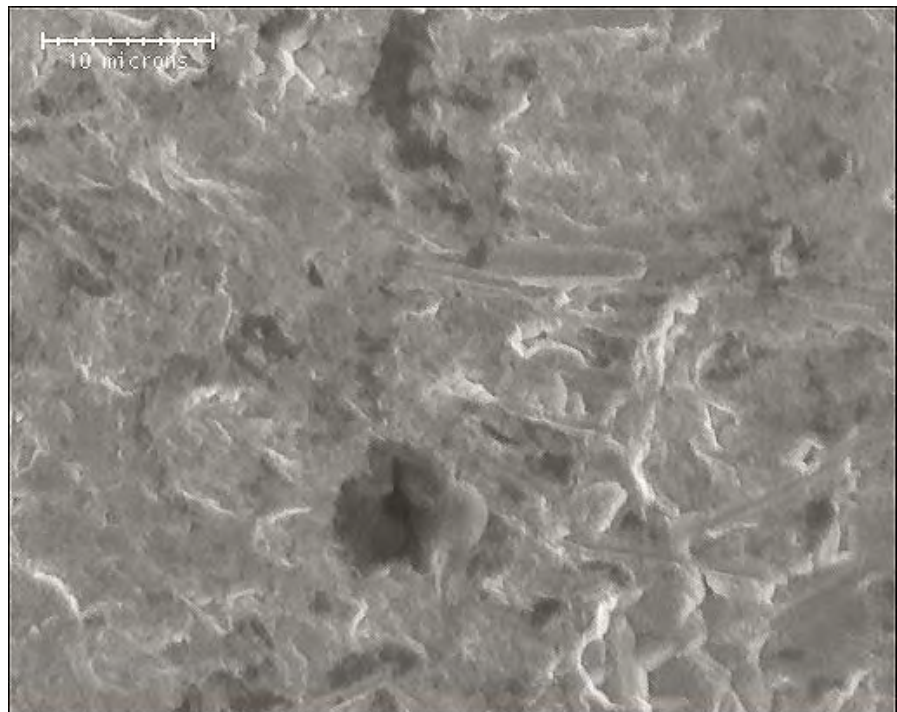


160S41W475KV4 #514-5389, time 0

Fig. 20

2500x magnification

Sample 5 - right



160S41W475KV4 #514-5389, time 0

160S41W475KV4 – pre Temp Humidity

Fig. 21

250x magnification

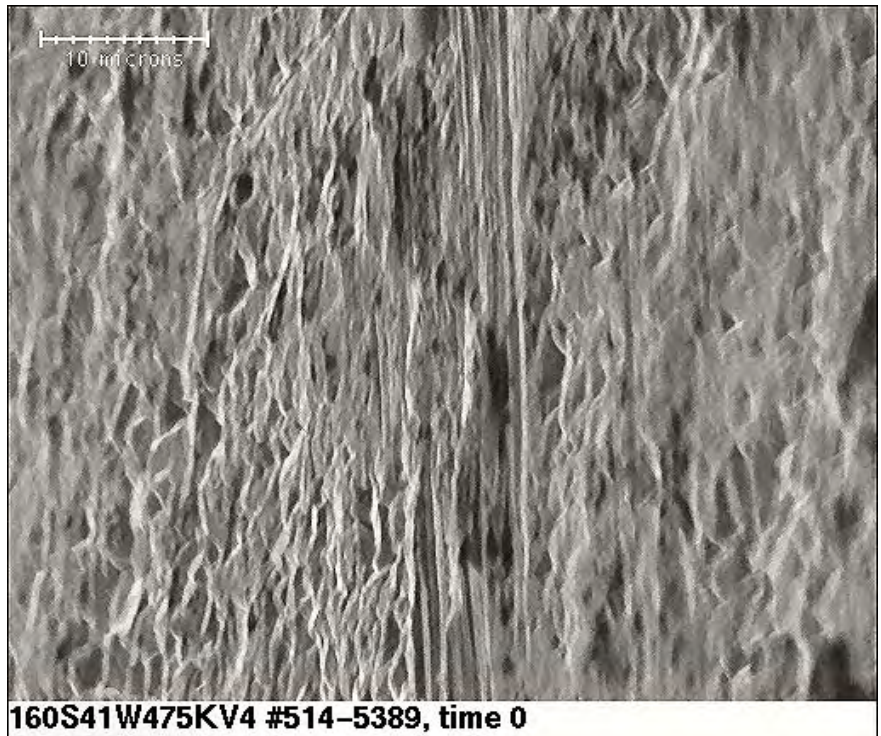
Sample 6 - left



Fig. 22

2500x magnification

Sample 6 - left



160S41W475KV4 – pre Temp Humidity

Fig. 23

250x magnification

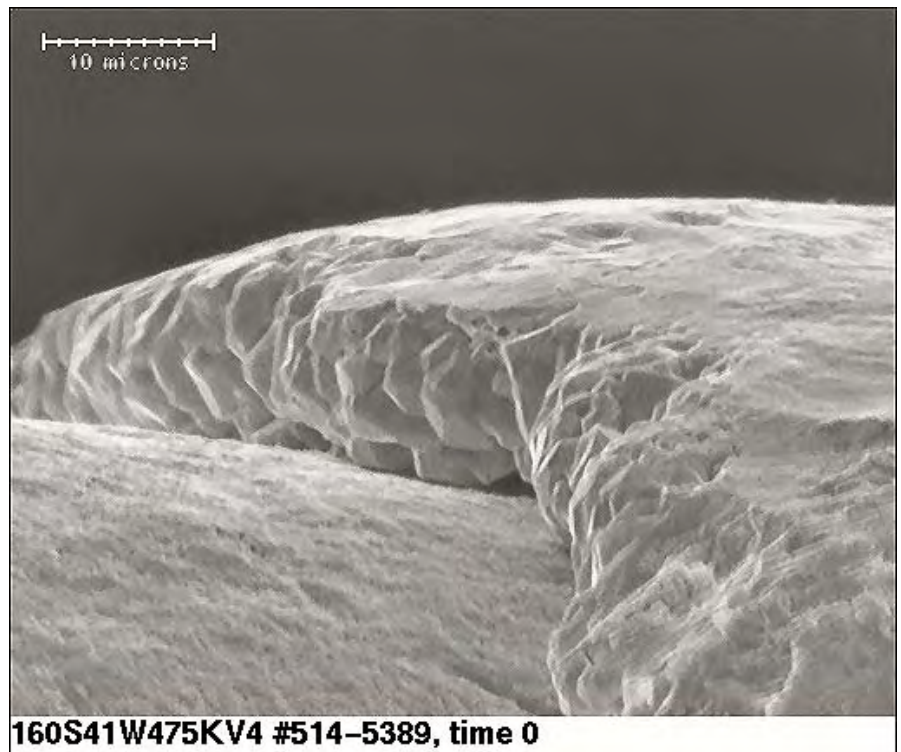
Sample 6 - right



Fig. 24

2500x magnification

Sample 6 - right



160S41W475KV4 – pre Temp Humidity

Fig. 25

250x magnification

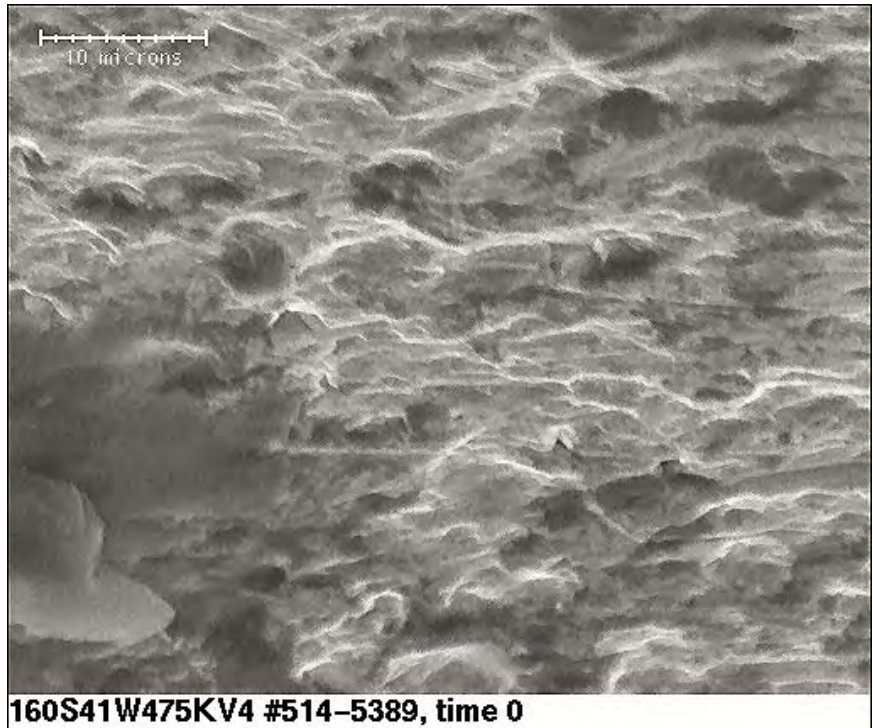
Sample 7 - left



Fig. 26

2500x magnification

Sample 7 - left



160S41W475KV4 – pre Temp Humidity

Fig. 27

250x magnification

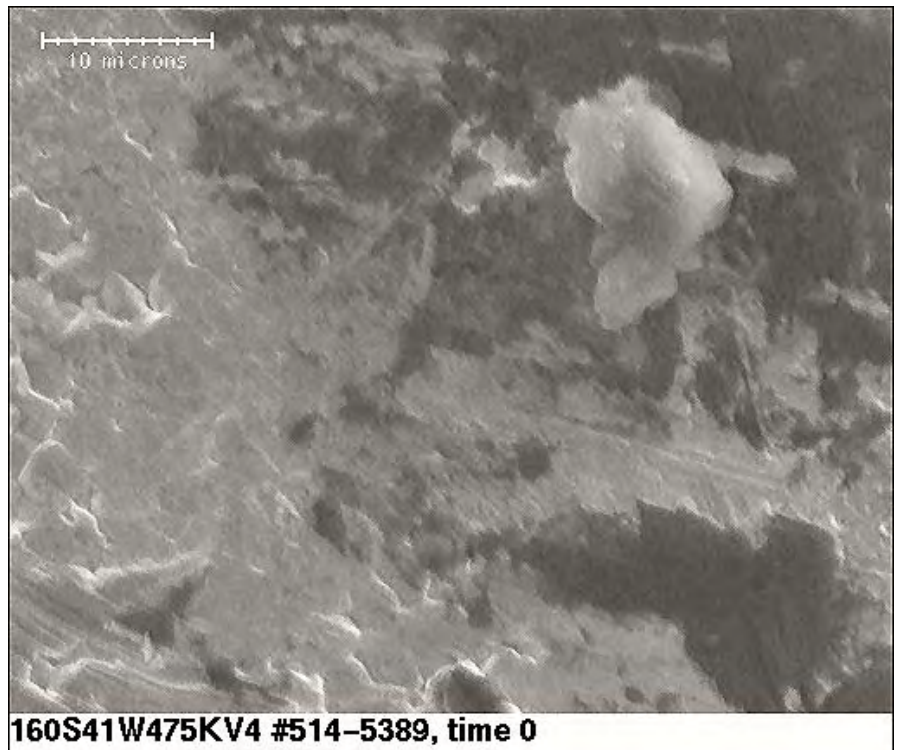
Sample 7 - right



Fig. 28

2500x magnification

Sample 7 - right



160S41W475KV4 – pre Temp Humidity

Fig. 29

250x magnification

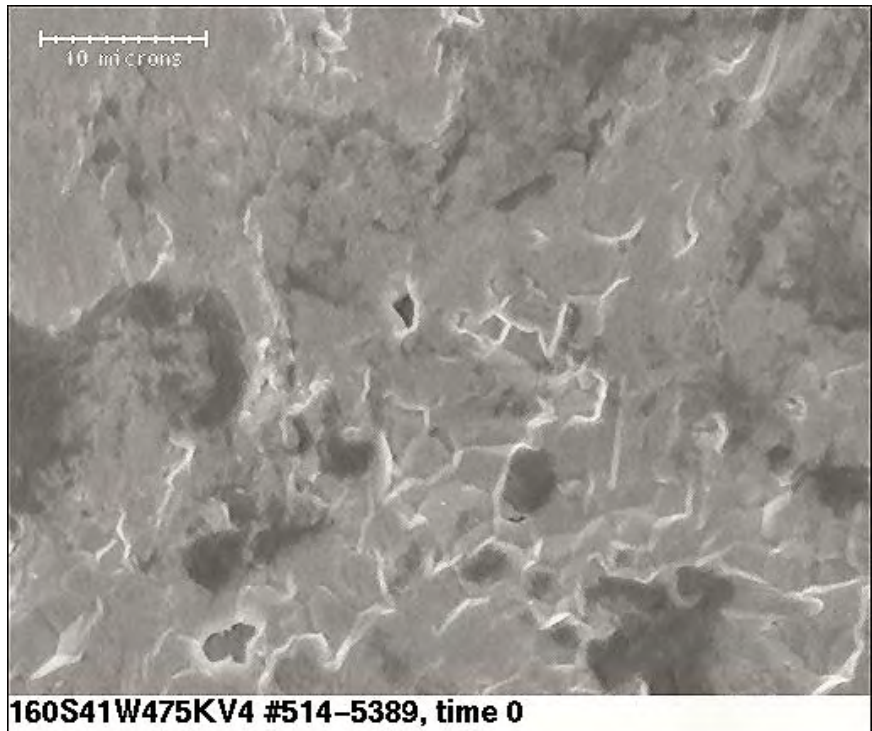
Sample 8 - left



Fig. 30

2500x magnification

Sample 8 - left



160S41W475KV4 – pre Temp Humidity

Fig. 31

250x magnification

Sample 8 - right

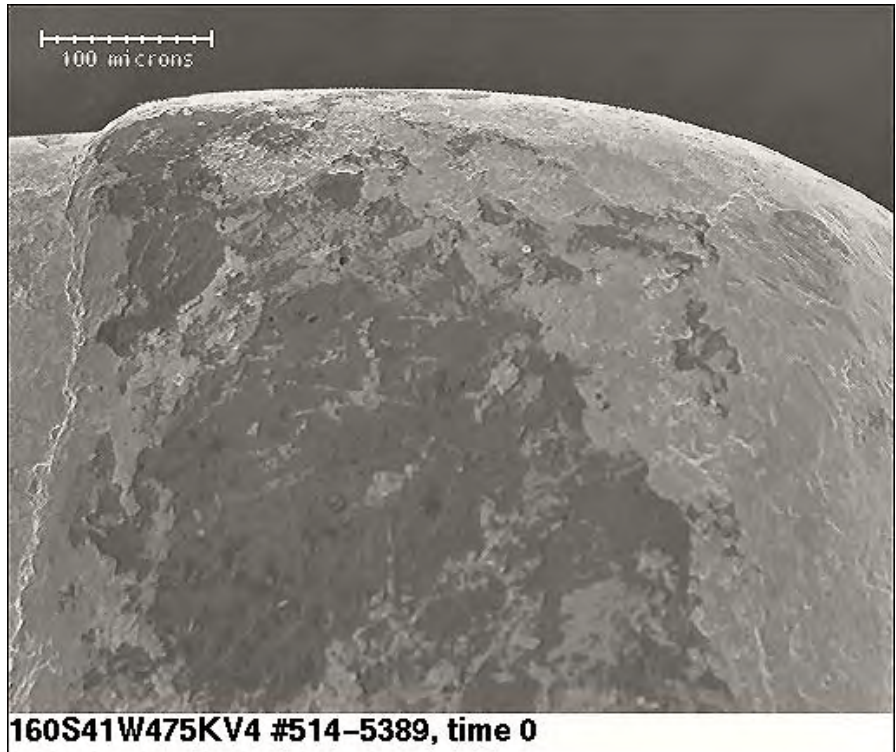
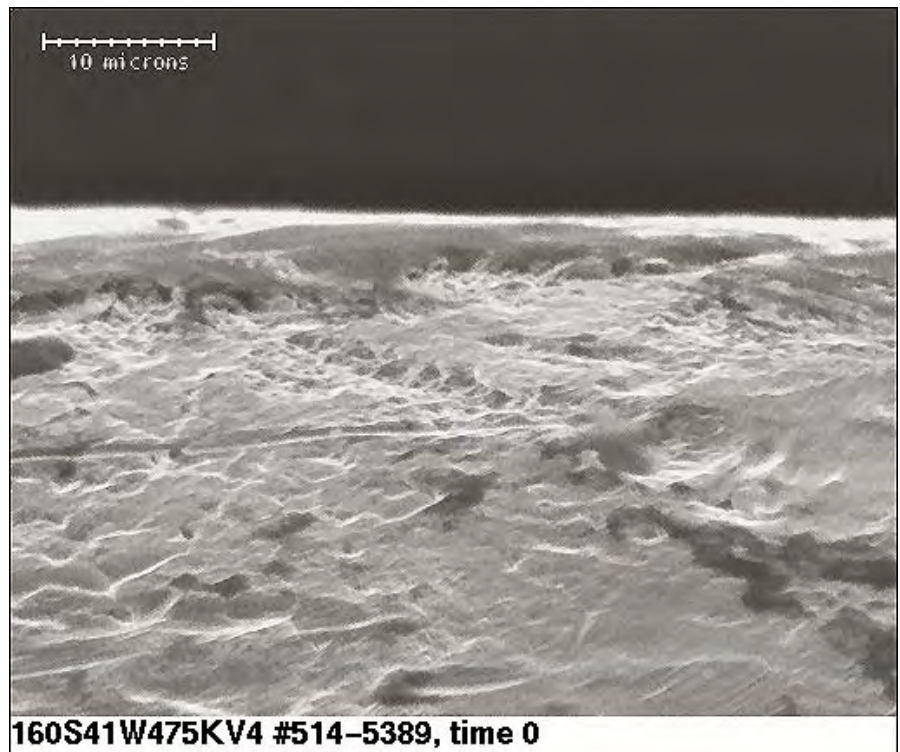


Fig. 32

2500x magnification

Sample 8 - right



160S41W475KV4 – pre Temp Humidity

Fig. 33

250x magnification

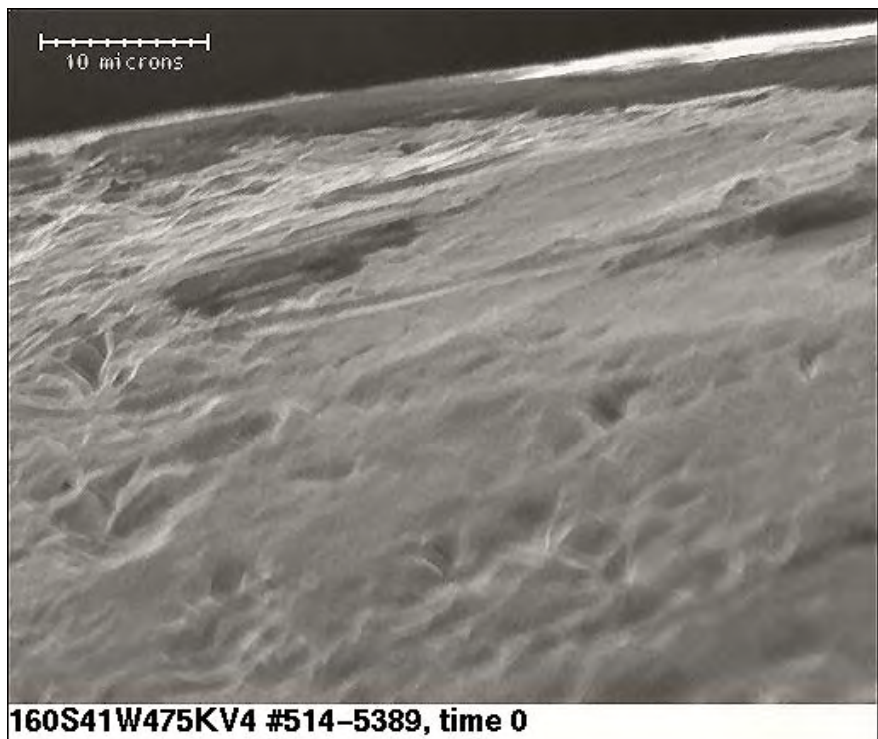
Sample 9 - left



Fig. 34

2500x magnification

Sample 9 - left



160S41W475KV4 – pre Temp Humidity

Fig. 35

250x magnification

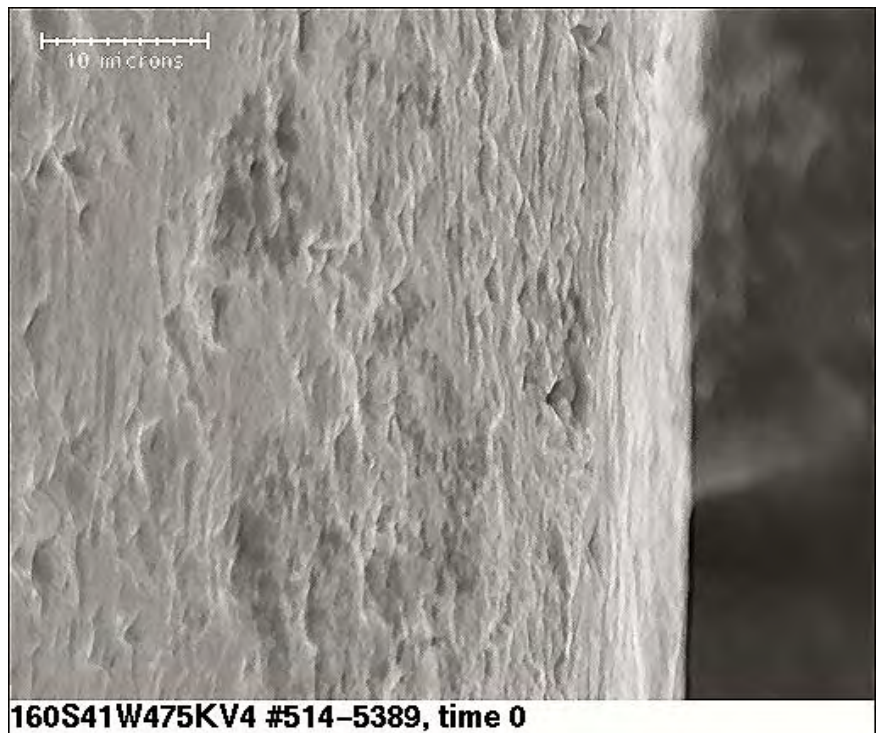
Sample 9 - right



Fig. 36

2500x magnification

Sample 9 - right



160S41W475KV4 – 1000 hours

Fig. 37

250x magnification

Sample 1 - left



Fig. 38

250x magnification

Sample 1 - right



160S41W475KV4 – 1000 hours

Fig. 39

250x magnification

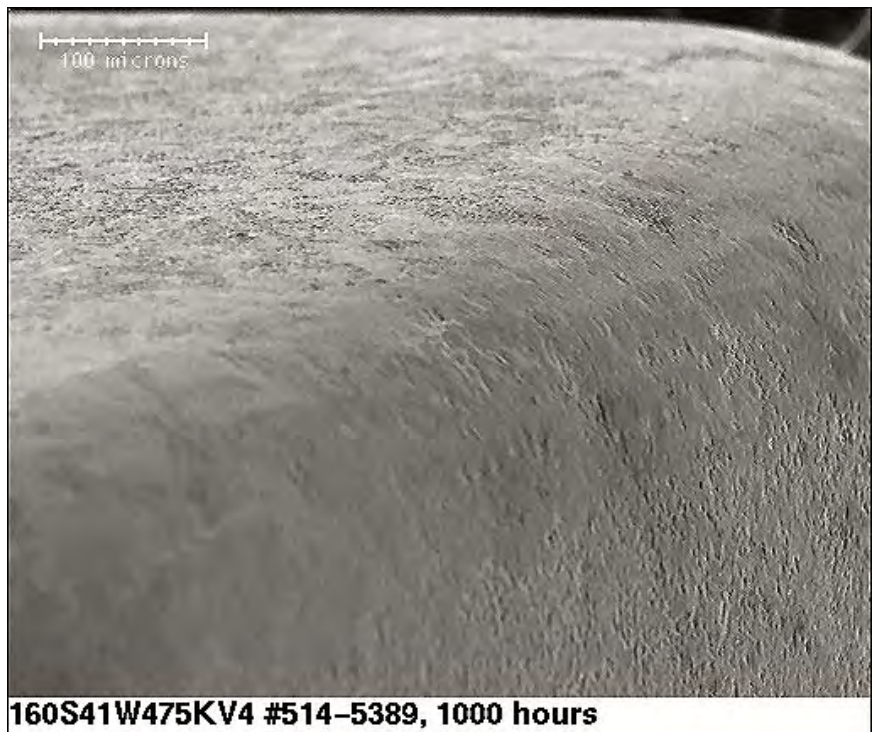
Sample 2 - left



Fig. 40

250x magnification

Sample 2 - right



160S41W475KV4 – 1000 hours

Fig. 41

250x magnification

Sample 3 - left



Fig. 42

250x magnification

Sample 3 - right



160S41W475KV4 – 1000 hours

Fig. 43

250x magnification

Sample 4 - left



Fig. 44

250x magnification

Sample 4 - right



160S41W475KV4 – 1000 hours

Fig. 45

250x magnification

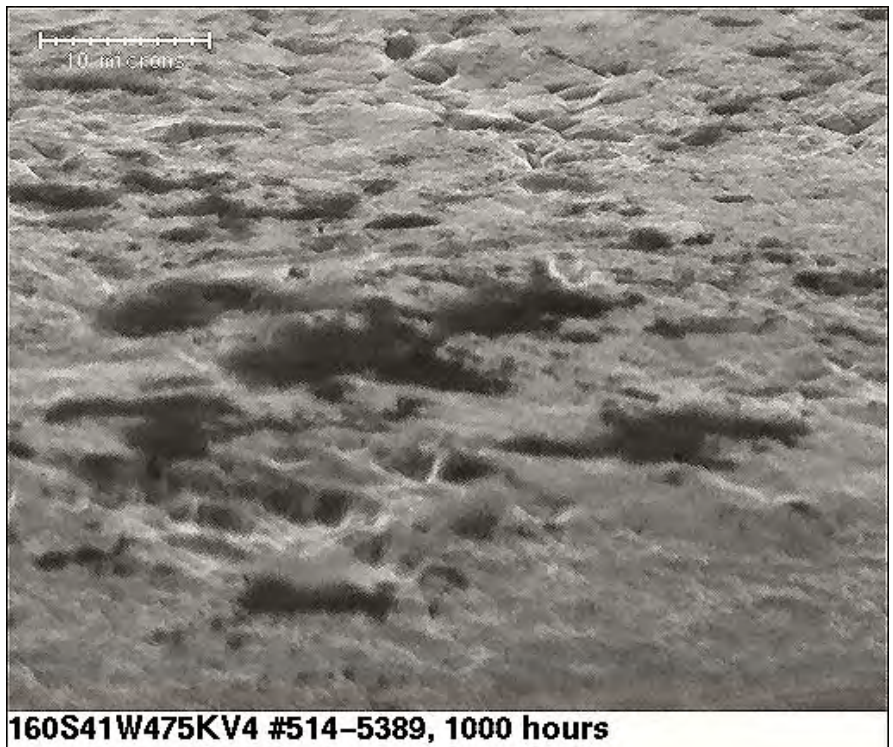
Sample 5 - left



Fig. 46

2500x magnification

Sample 5 - left

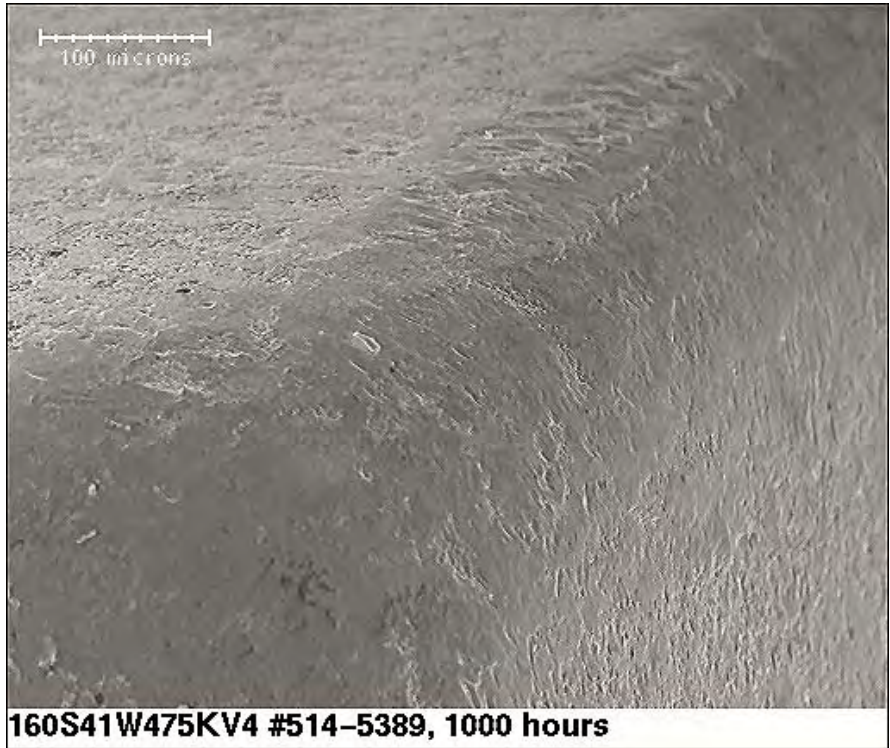


160S41W475KV4 – 1000 hours

Fig. 47

250x magnification

Sample 5 - right



160S41W475KV4 – 1000 hours

Fig. 48

250x magnification

Sample 6 - left



Fig. 49

250x magnification

Sample 6 - right



160S41W475KV4 – 1000 hours

Fig. 50

250x magnification

Sample 7 - left

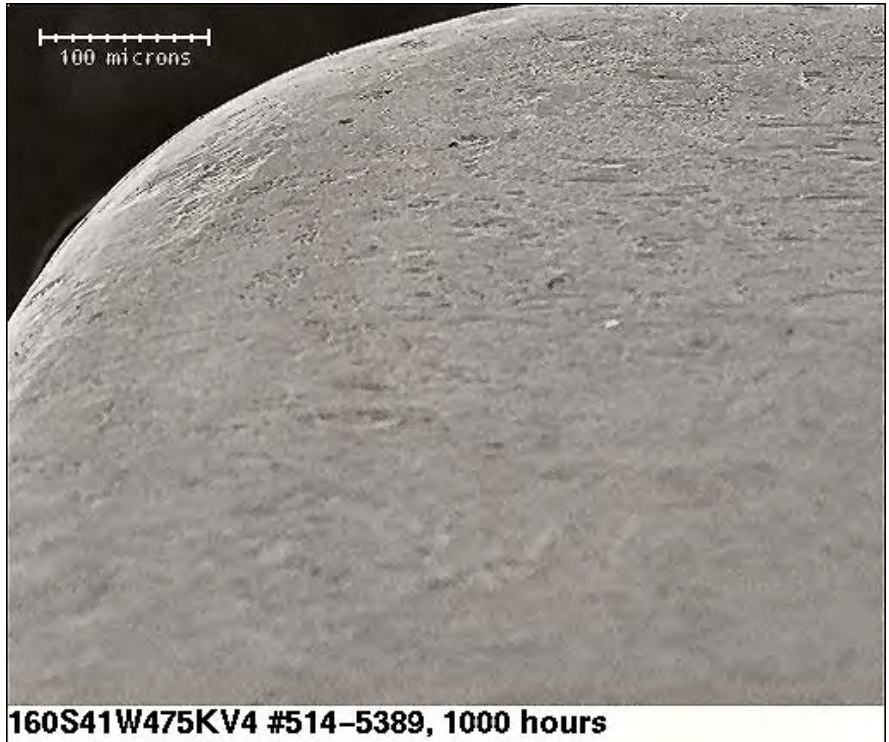


Fig. 51

250x magnification

Sample 7 - right



160S41W475KV4 – 1000 hours

Fig. 52

250x magnification

Sample 8 - left



Fig. 53

250x magnification

Sample 8 - right



160S41W475KV4 – 1000 hours

Fig. 54

250x magnification

Sample 9 - left



Fig. 55

250x magnification

Sample 9 - right



160S41W475KV4 – 4000 hours

Fig. 56

250x magnification

Sample 1 - left

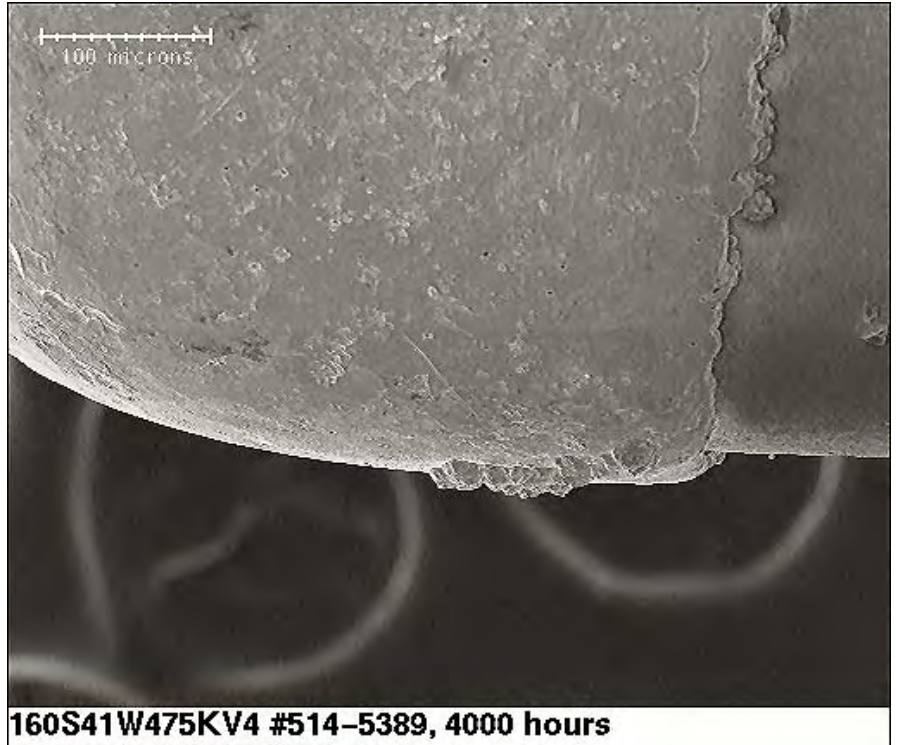
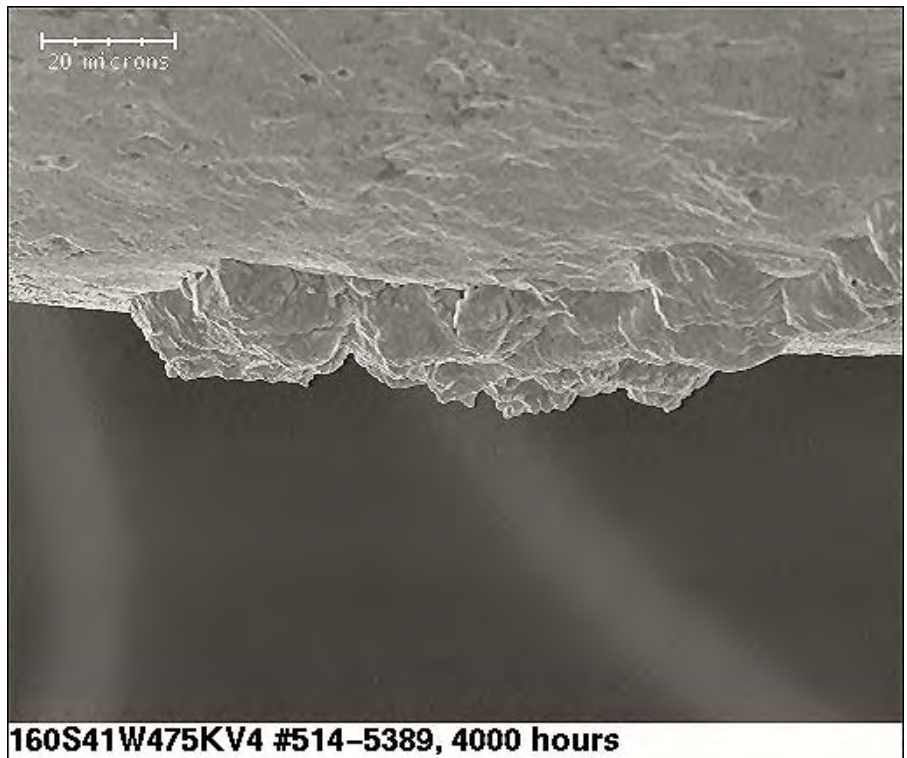


Fig. 57

1000x magnification

Sample 1 - left



160S41W475KV4 – 4000 hours

Fig. 58

250x magnification

Sample 1 - right

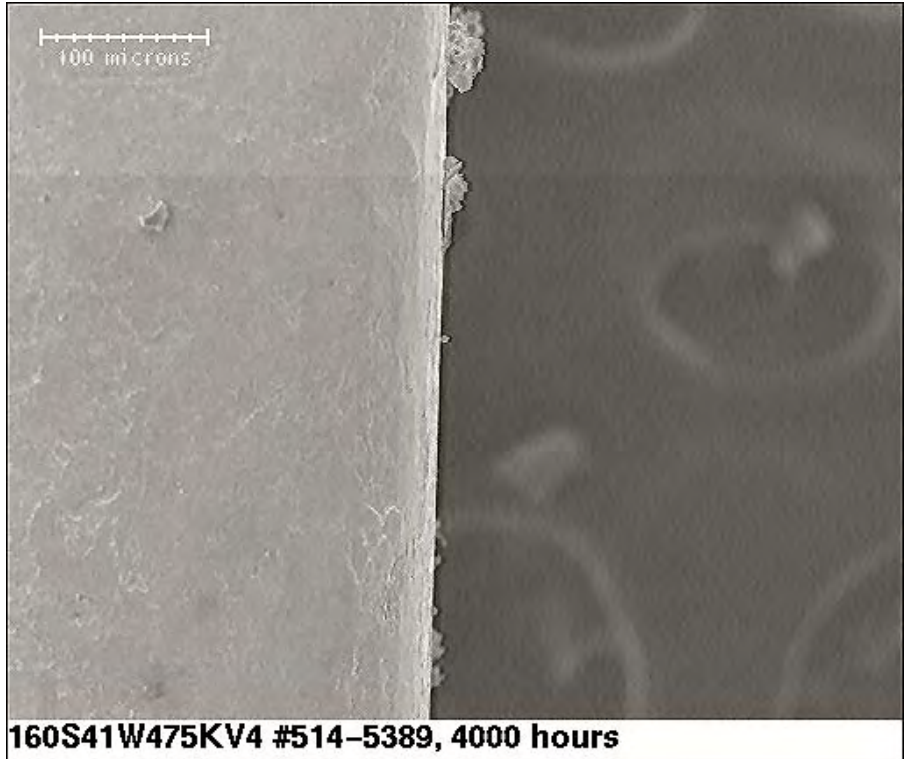
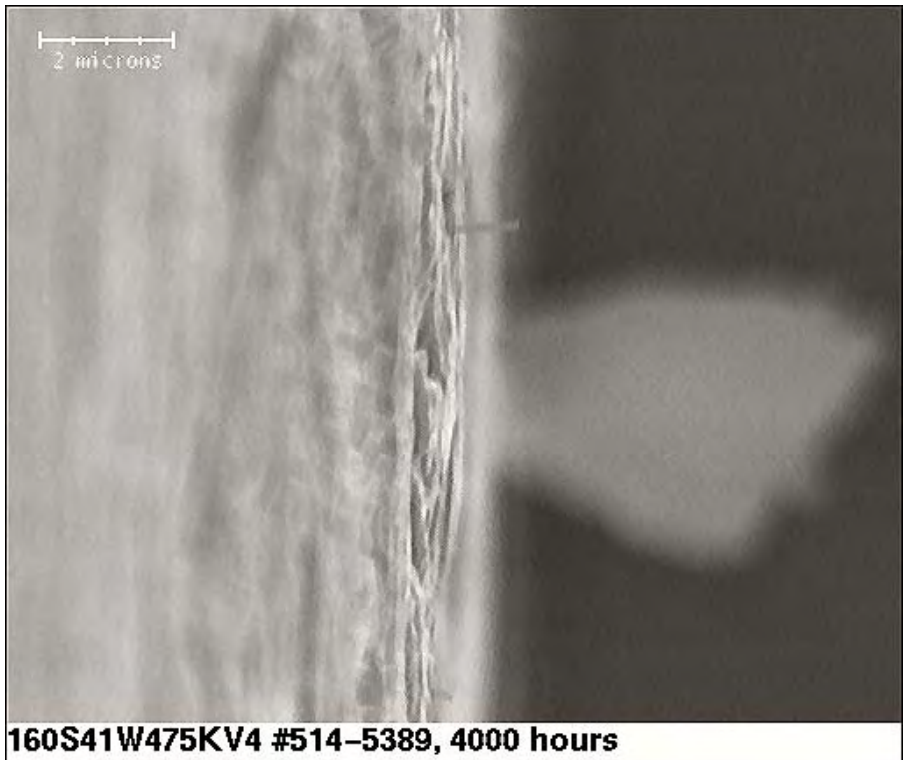


Fig. 59

10,000x magnification

Sample 1 - right



160S41W475KV4 – 4000 hours

Fig. 60

250x magnification

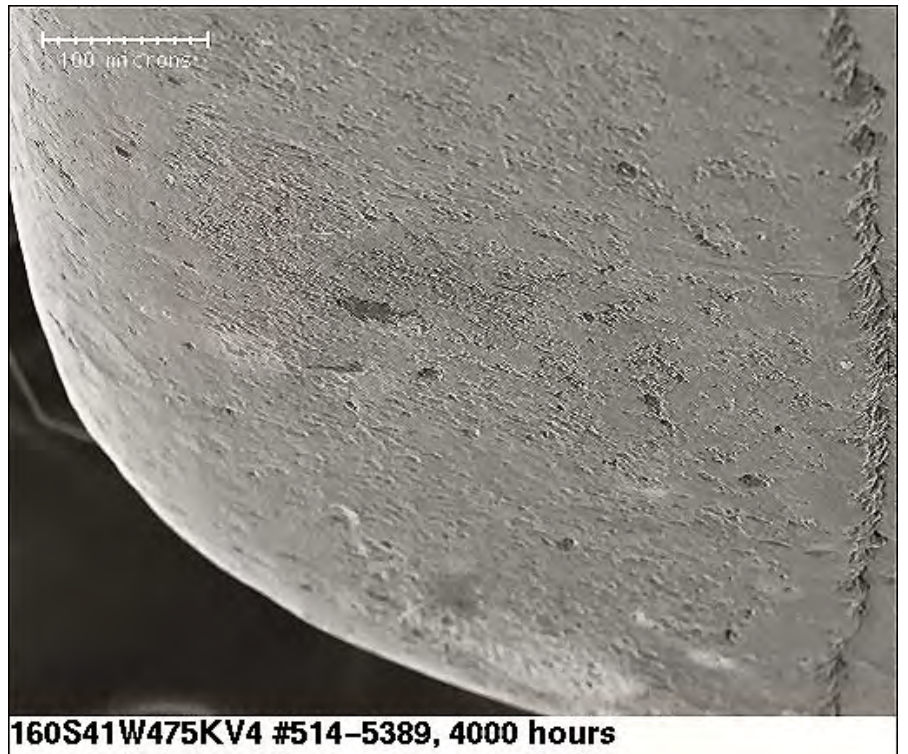
Sample 2 - left



Fig. 61

250x magnification

Sample 3 - left



160S41W475KV4 – 4000 hours

Fig. 62

250x magnification

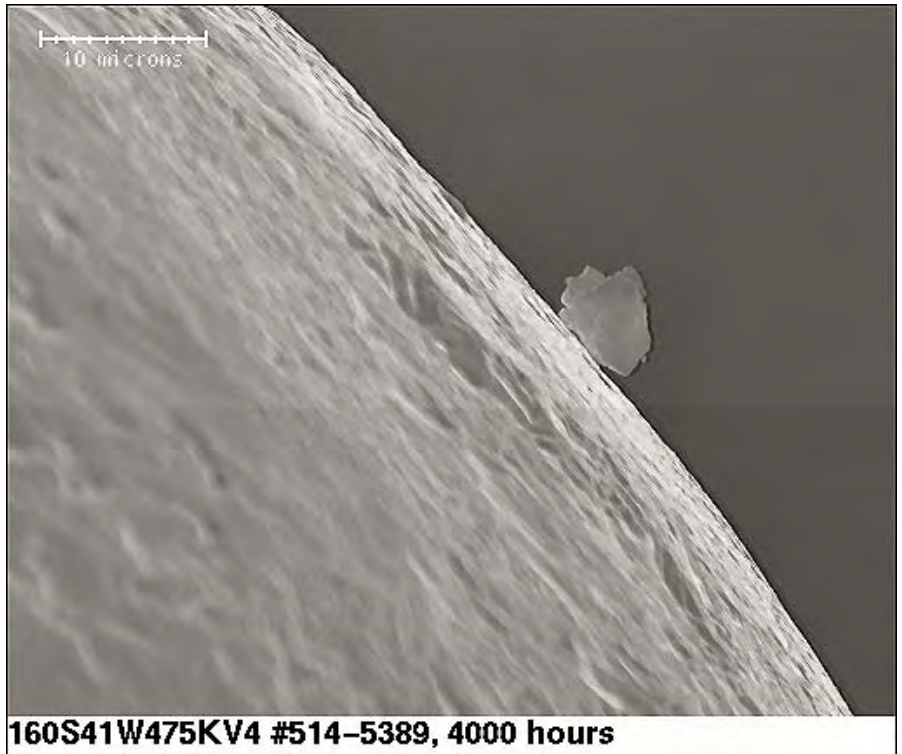
Sample 2 - right



Fig. 63

2500x magnification

Sample 2 - right



160S41W475KV4 – 4000 hours

Fig. 64

250x magnification

Sample 3 - right



Fig. 65

2500x magnification

Sample 3 - right



160S41W475KV4 – 4000 hours

Fig. 66

250x magnification

Sample 4 - left

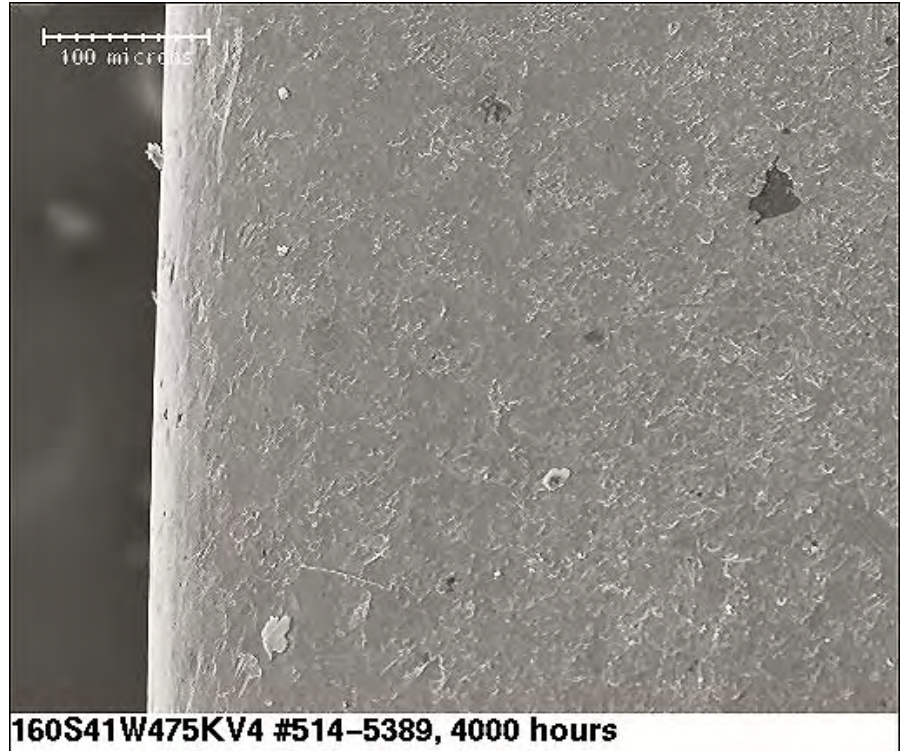
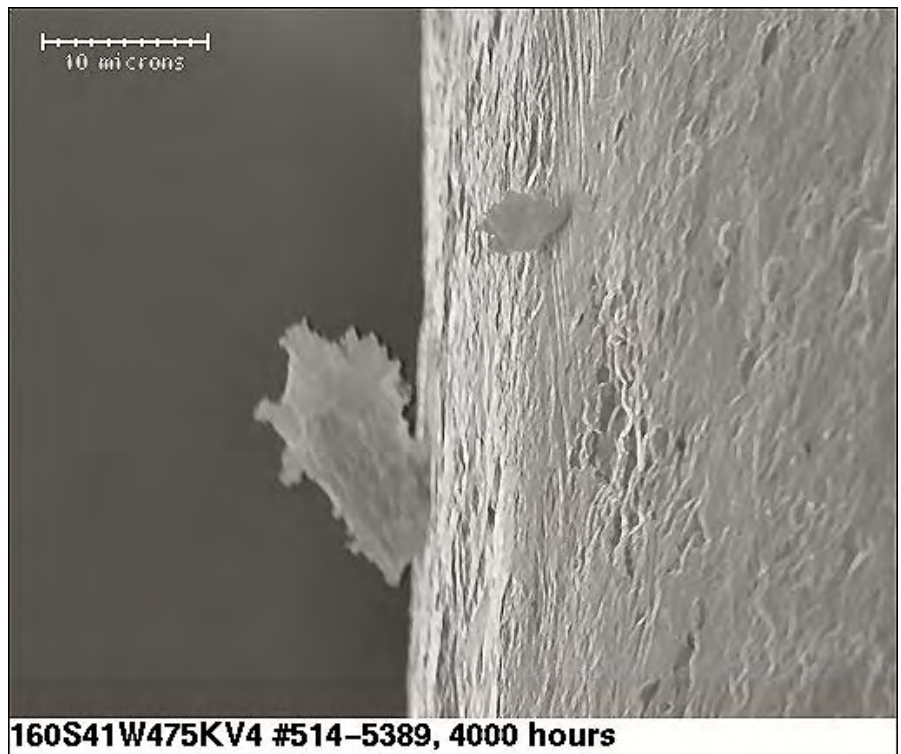


Fig. 67

2500x magnification

Sample 4 - left



160S41W475KV4 – 4000 hours

Fig. 68

250x magnification

Sample 4 - right



160S41W475KV4 – 4000 hours

Fig. 69

250x magnification

Sample 5 - left

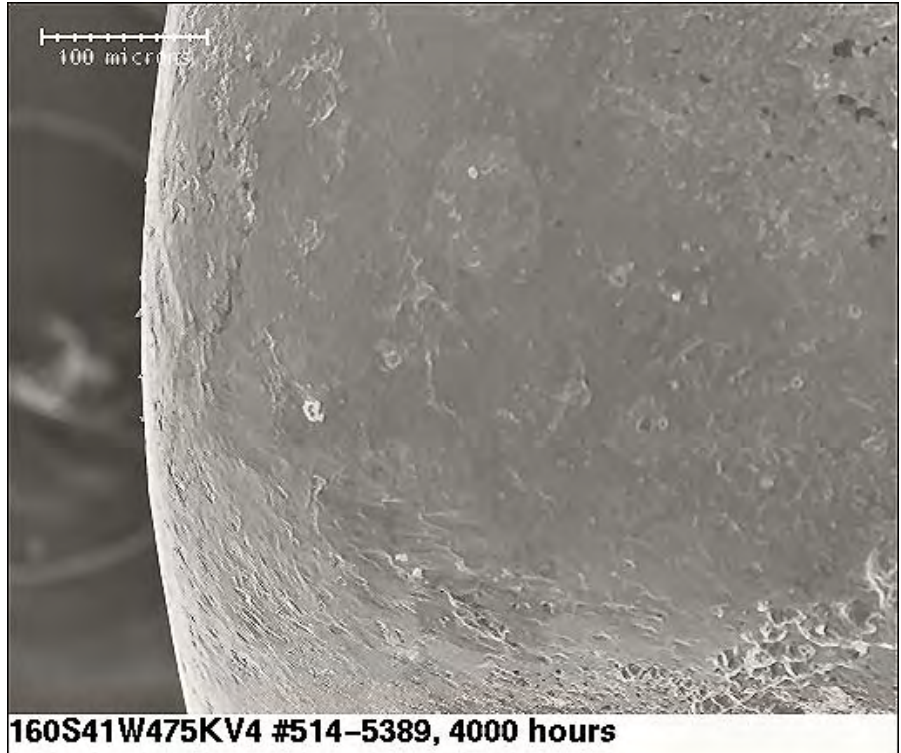
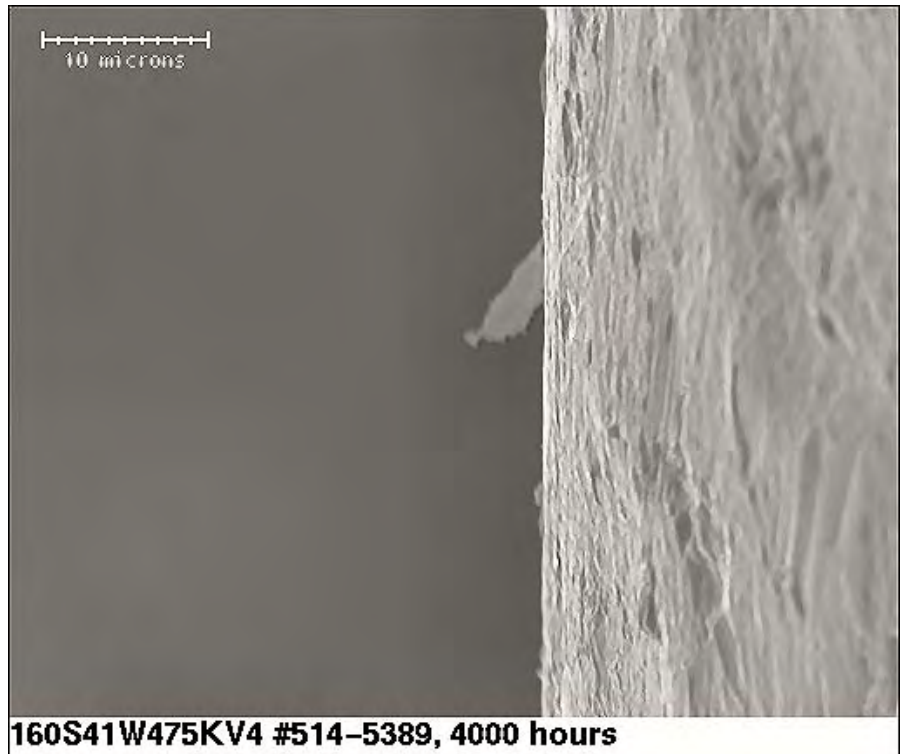


Fig. 70

2500x magnification

Sample 5 - left

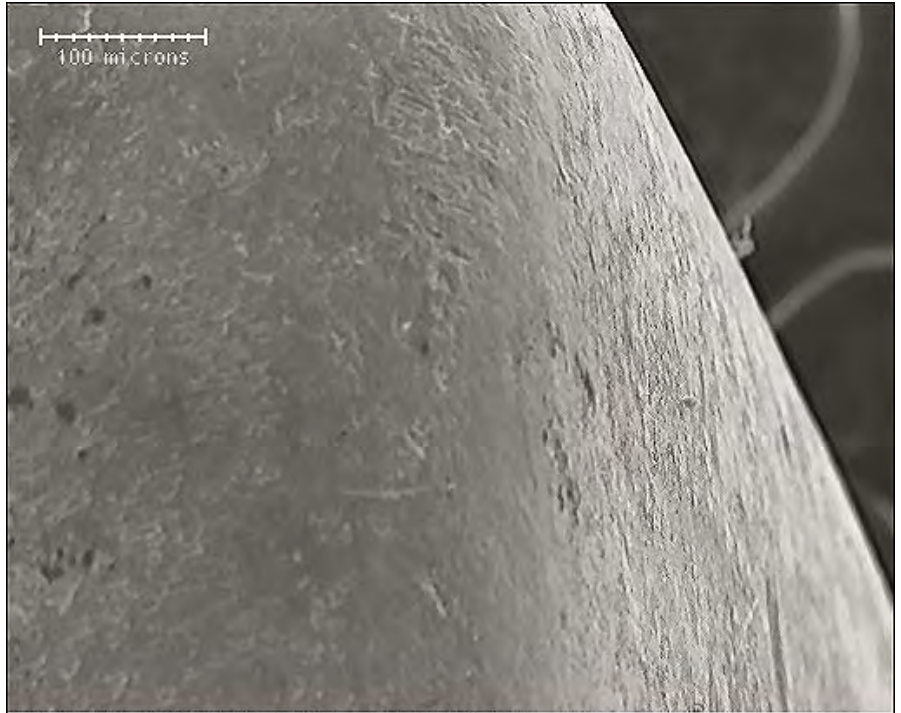


160S41W475KV4 – 4000 hours

Fig. 71

250x magnification

Sample 5 - right



160S41W475KV4 #514-5389, 4000 hours

Fig. 72

2500x magnification

Sample 5 - right



160S41W475KV4 #514-5389, 4000 hours

160S41W475KV4 – 4000 hours

Fig. 73

250x magnification

Sample 6 - left



160S41W475KV4 – 4000 hours

Fig. 74

250x magnification

Sample 6 - right

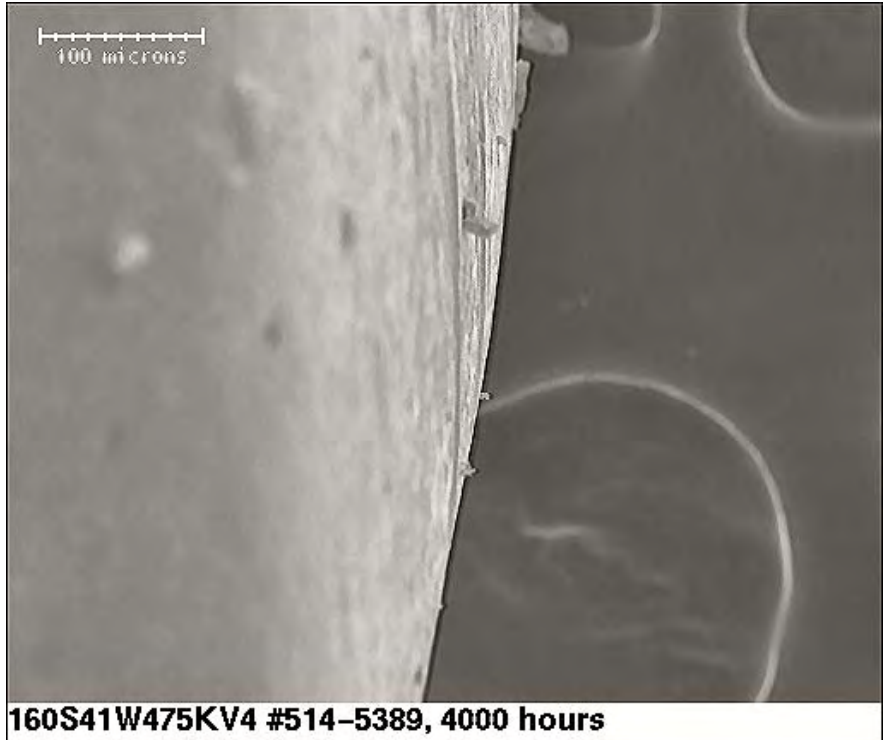
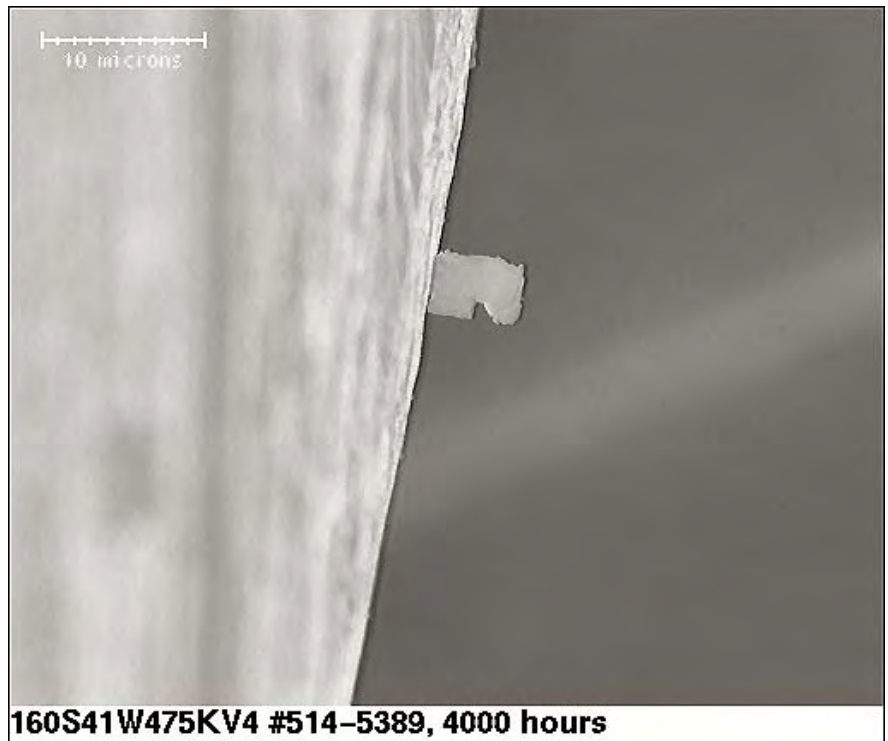


Fig. 75

2500x magnification

Sample 6 - right



160S41W475KV4 – 4000 hours

Fig. 76

250x magnification

Sample 7 - left



Fig. 77

2500x magnification

Sample 7 - left

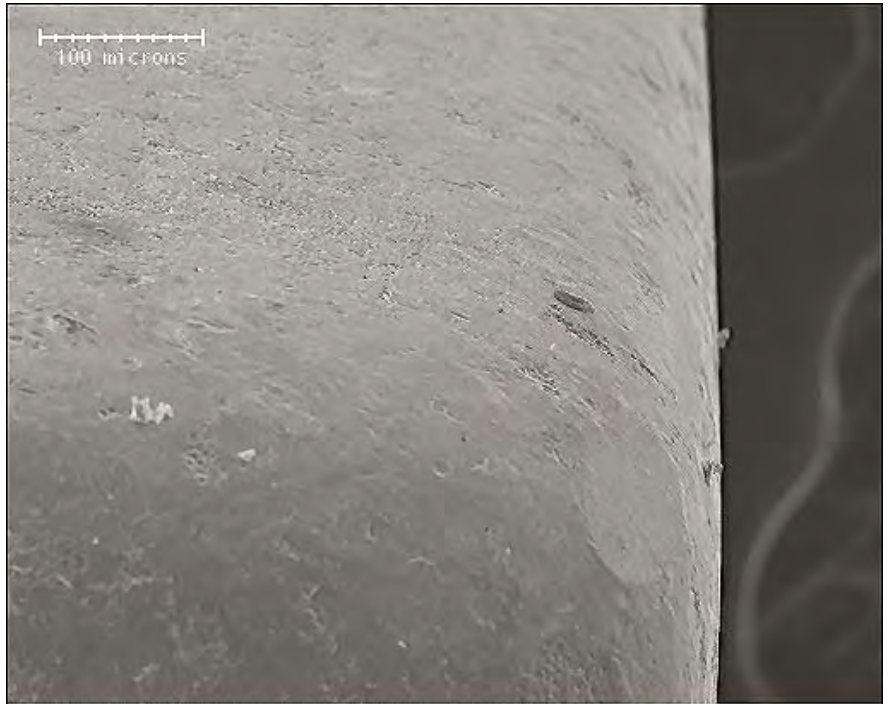


160S41W475KV4 – 4000 hours

Fig. 78

250x magnification

Sample 7 - right

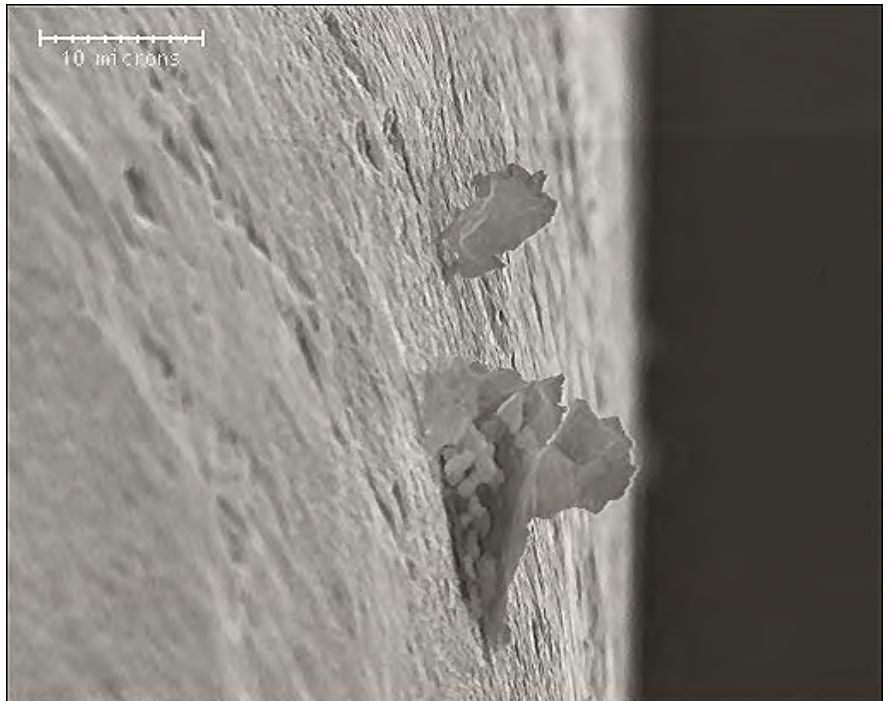


160S41W475KV4 #514-5389, 4000 hours

Fig. 79

2500x magnification

Sample 7 - right



160S41W475KV4 #514-5389, 4000 hours

160S41W475KV4 – 4000 hours

Fig. 80

250x magnification

Sample 8 - left



160S41W475KV4 – 4000 hours

Fig. 81

250x magnification

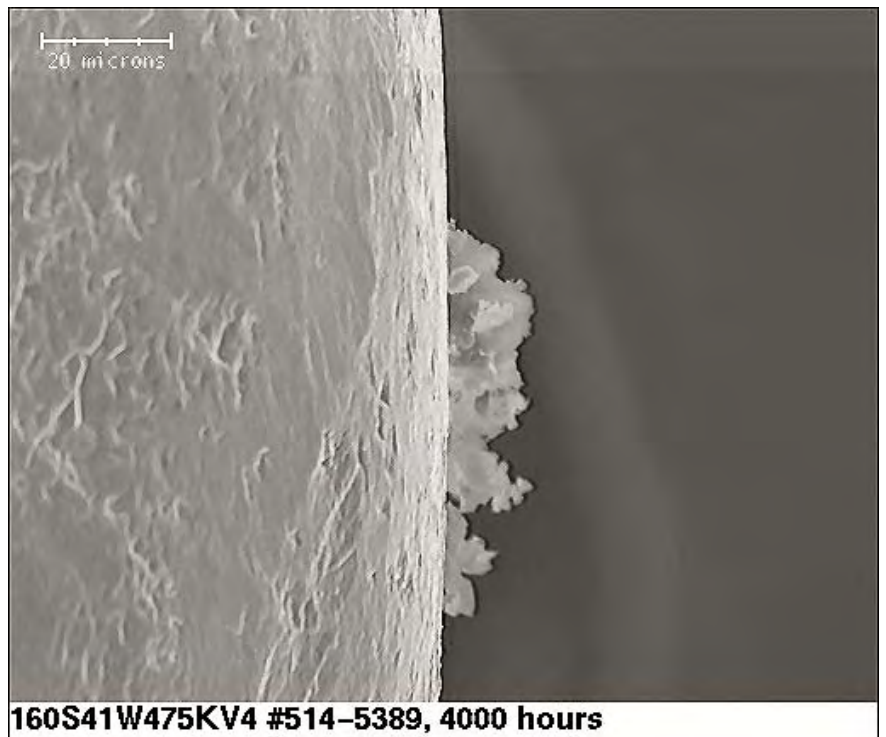
Sample 8 - right



Fig. 82

1000x magnification

Sample 8 - right



160S41W475KV4 – 4000 hours

Fig. 83

250x magnification

Sample 9 - left

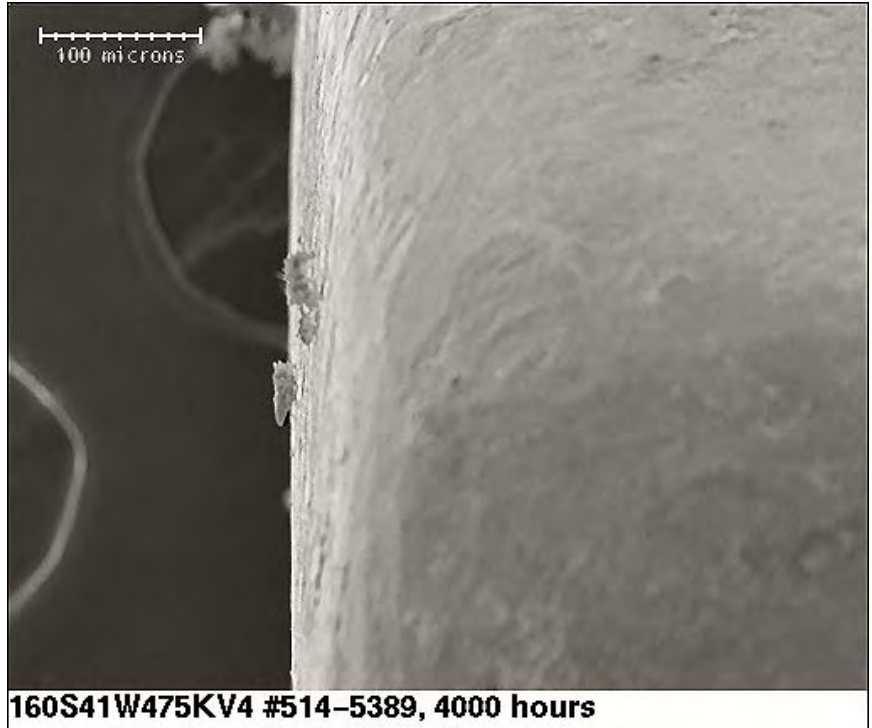


Fig. 84

250x magnification

Sample 9 - right

