



Subject: Laboratory Report # OEM138-002
Submitter: Omar Al Taher, Johanson Dielectrics, Inc.
Description: Tin Whisker Qualification by
Temperature Humidity Stress,
Part # # 500R15W473KV4 100% Sn
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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: **500R15W473KV4 lot #514-7276 100% Sn, 0805 size**

Summary:

- Fifteen capacitors with a total of 30 terminations were scanned for the presence of whiskers pre- and post- temperature humidity stress. The capacitors were labeled '1' through '15'. 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 - 35).
- **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 30 terminations.
- Representative images were made of the capacitor terminations after 1000 hours (fig. 36 - 55) and 4000 hours (fig. 56 - 105) 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'.
- No whiskers were observed post-1000 hours or post-4000 hours of temperature humidity stress on any of the 30 terminations.
- Non-whisker solder anomalies were observed on several capacitors (example - capacitor #1, left side, fig 56, 57).

Conclusion:

- As per JEDEC std. JESD22A121 definitions, no tin whiskers were observed on the fifteen stressed, **500R15W473KV4 lot #514-7276 100% Sn, 0805 size**, capacitors after 4000 hours at 60C/93%RH.

500R15W473KV4 – pre Temp Humidity

Fig. 1

250x magnification

Sample 1 - left

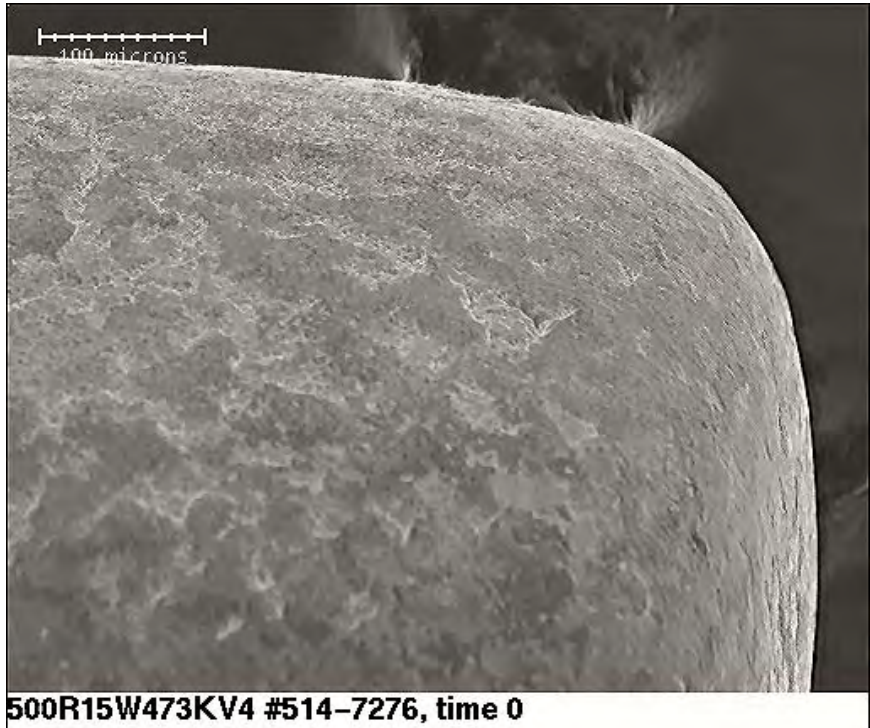


Fig. 2

2500x magnification

Sample 1 - left



500R15W473KV4 – pre Temp Humidity

Fig. 3

250x magnification

Sample 1 - right

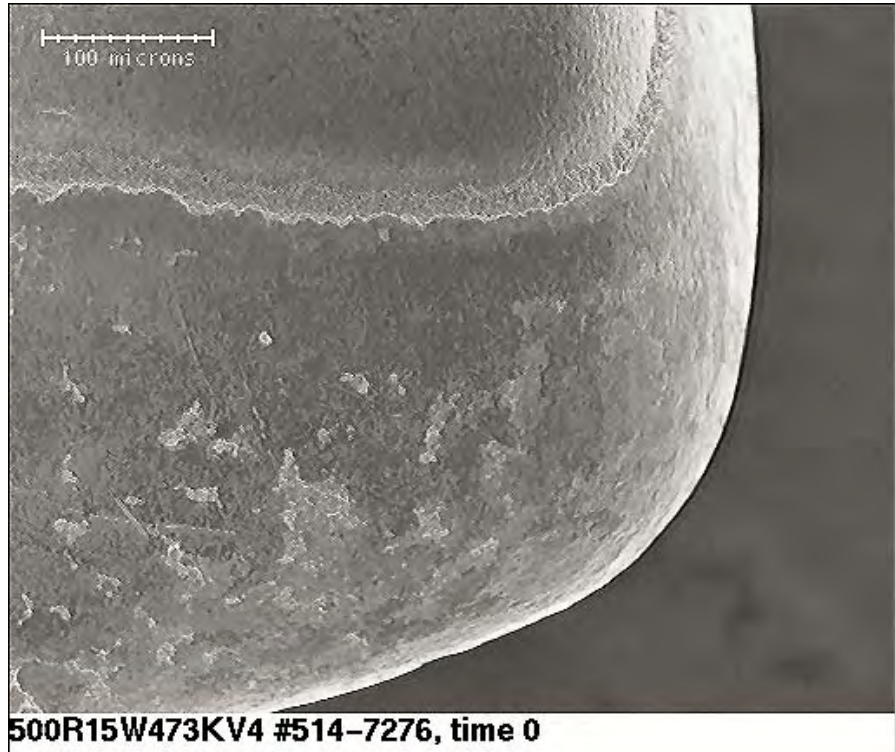


Fig. 4

2500x magnification

Sample 1 - right



500R15W473KV4 – pre Temp Humidity

Fig. 5

250x magnification

Sample 2 - left

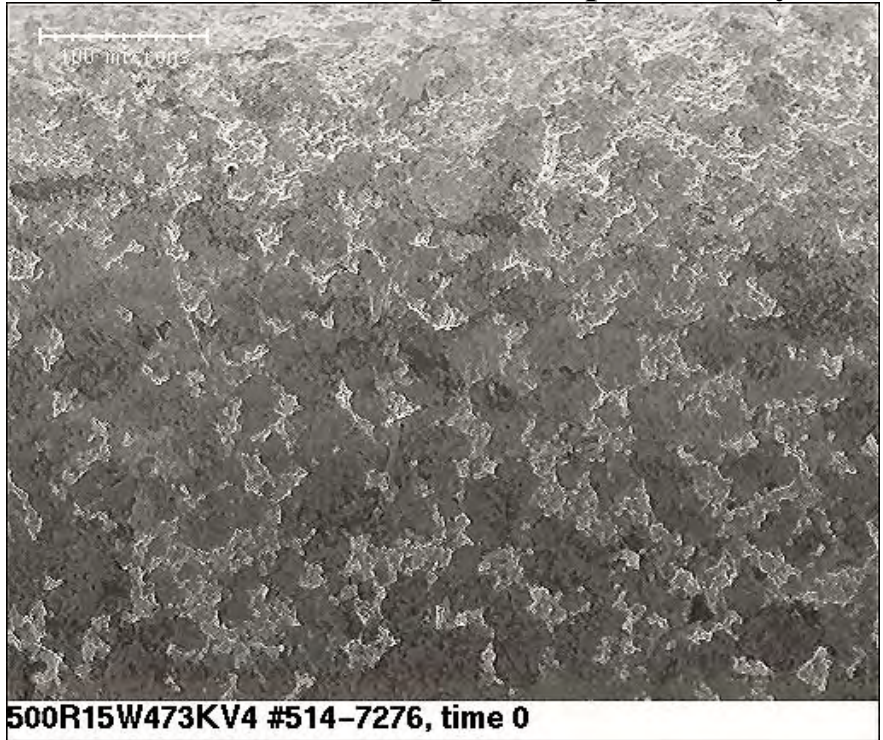
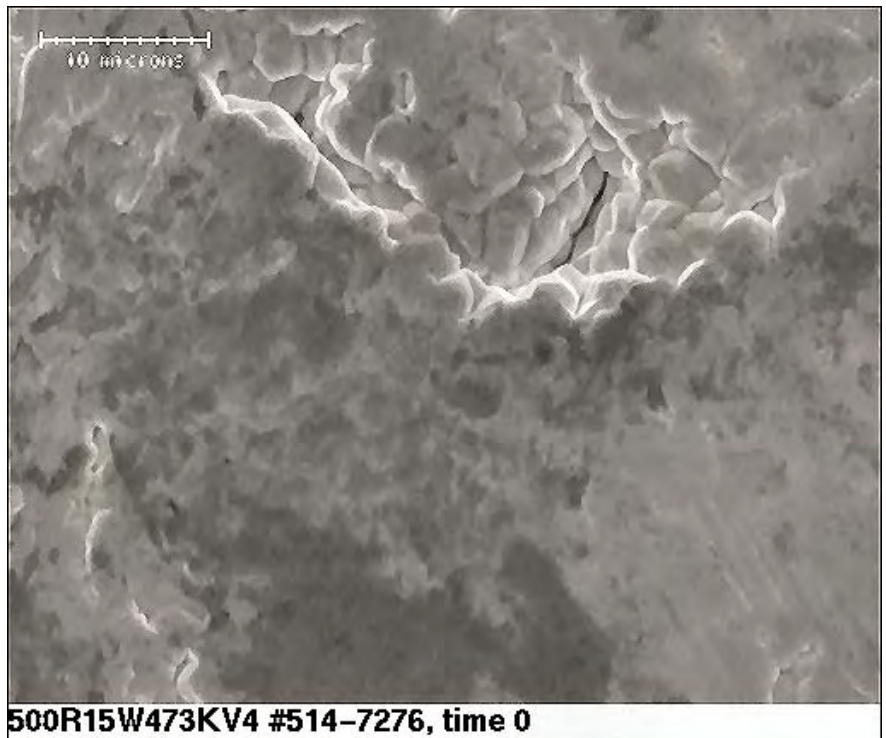


Fig. 6

2500x magnification

Sample 2 - left



500R15W473KV4 – pre Temp Humidity

Fig. 7

250x magnification

Sample 2 - right

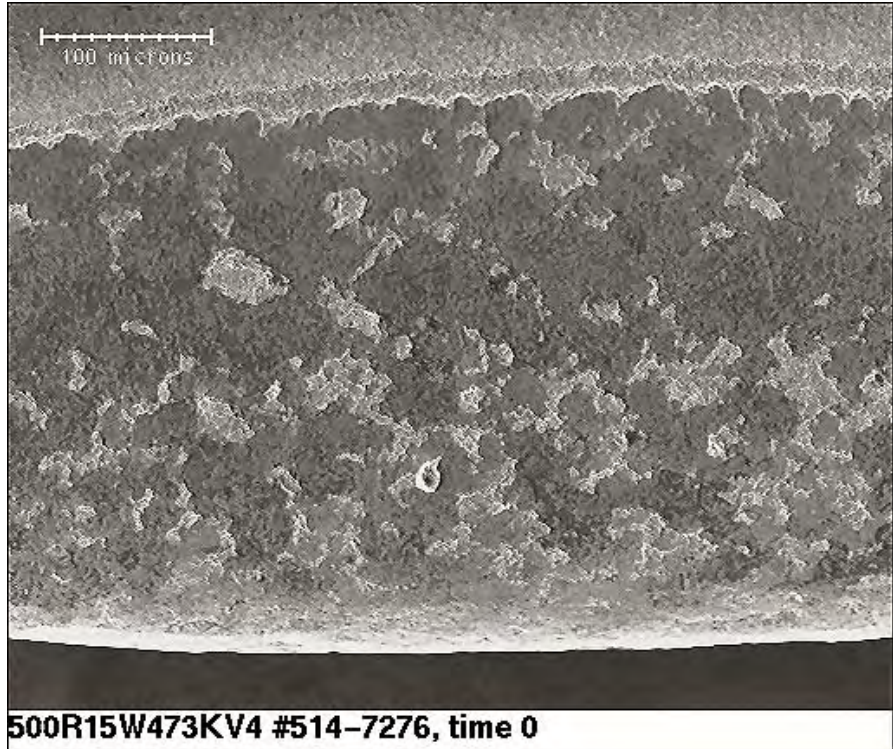


Fig. 8

2500x magnification

Sample 2 - right

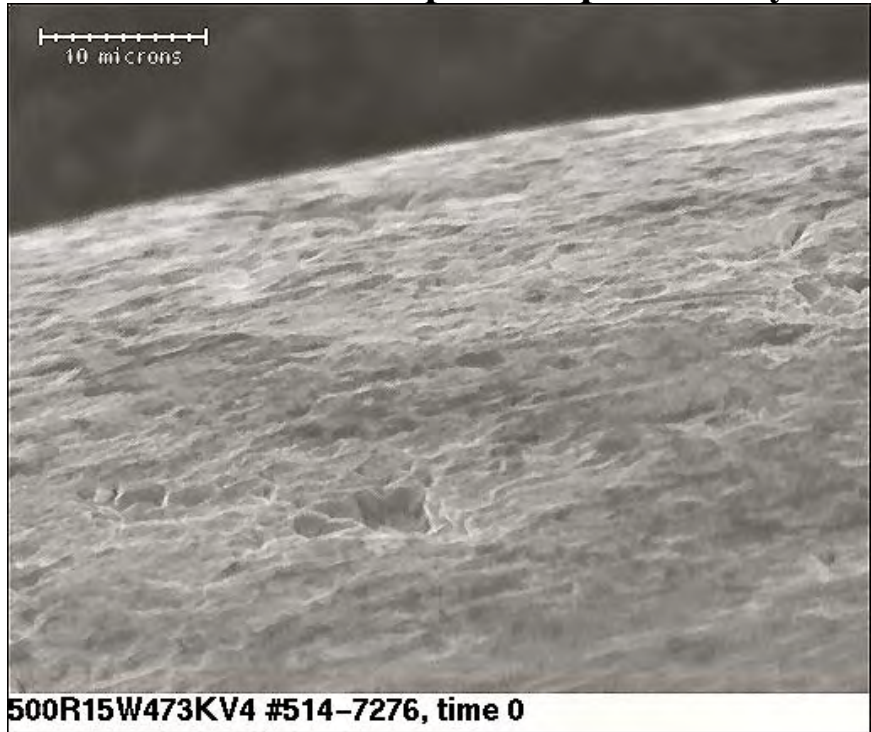


500R15W473KV4 – pre Temp Humidity

Fig. 9

250x magnification

Sample 3 - left



500R15W473KV4 – pre Temp Humidity

Fig. 10

250x magnification

Sample 3 - right

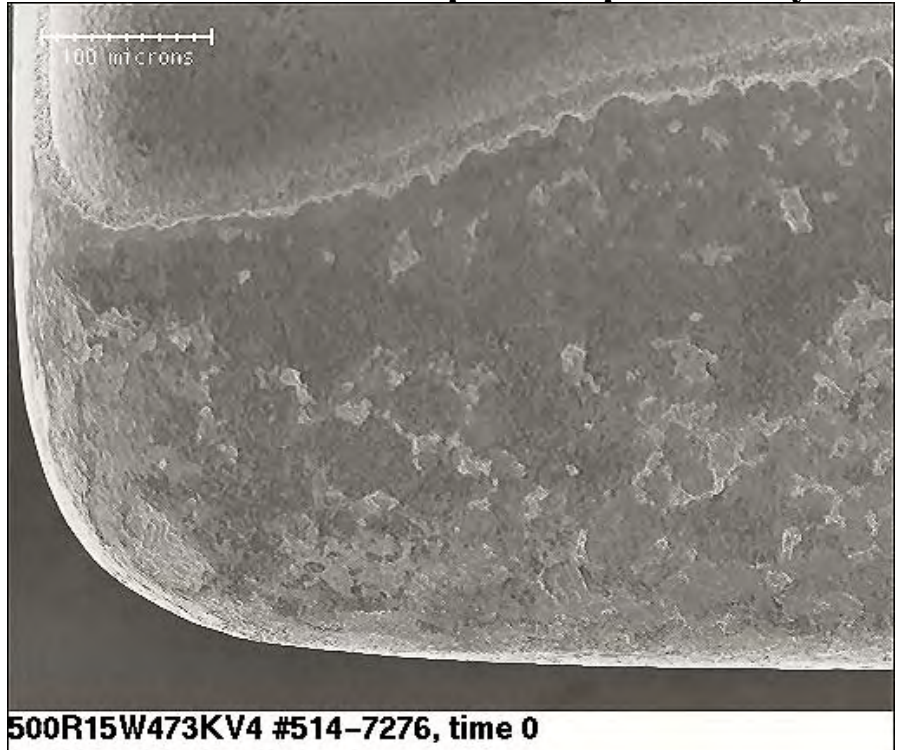


Fig. 11

2500x magnification

Sample 3 - right



500R15W473KV4 – pre Temp Humidity

Fig. 12

250x magnification

Sample 6 - left



Fig. 13

2500x magnification

Sample 6 - left



500R15W473KV4 – pre Temp Humidity

Fig. 14

250x magnification

Sample 6 - right

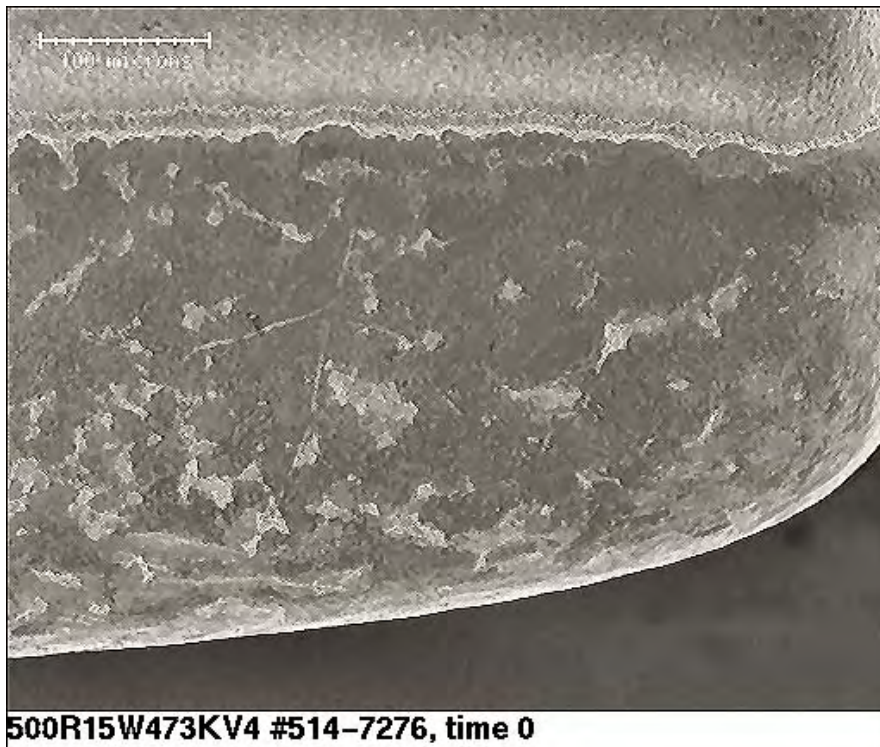
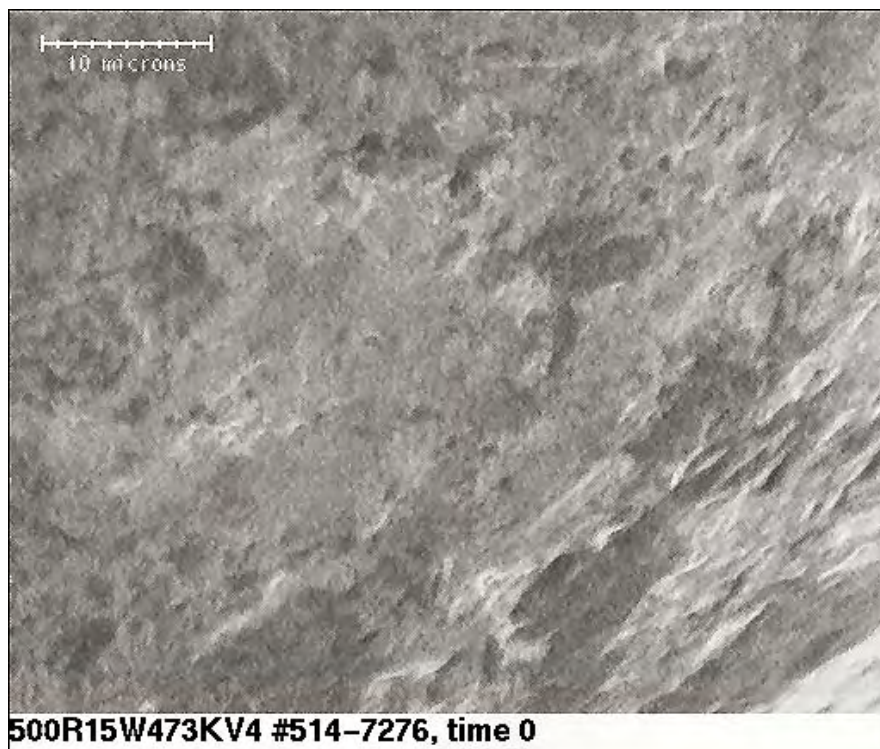


Fig. 15

2500x magnification

Sample 6 - right



500R15W473KV4 – pre Temp Humidity

Fig. 16

250x magnification

Sample 7 - left

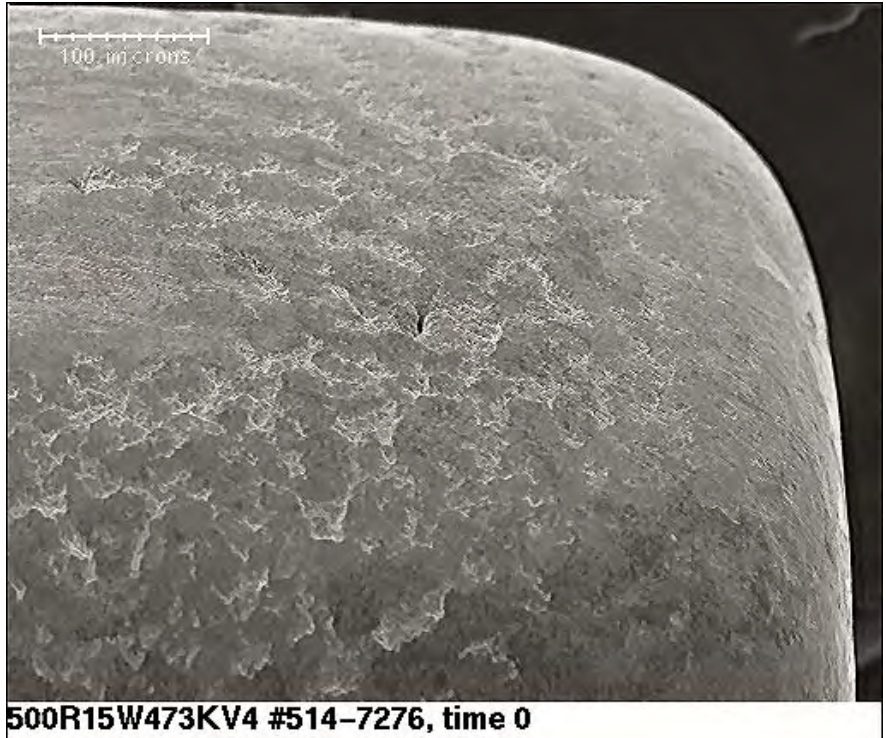
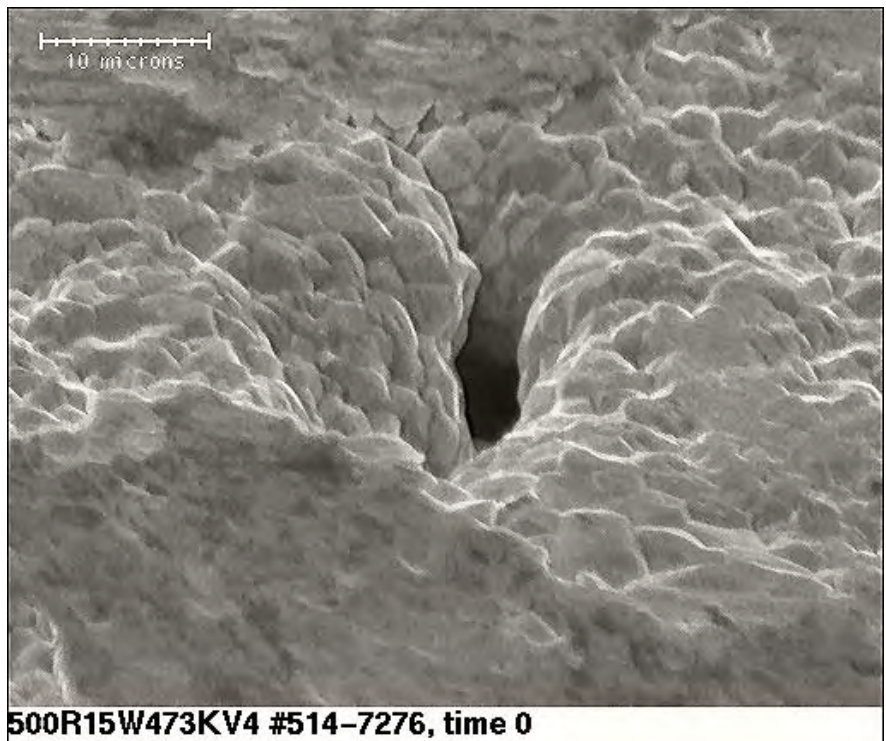


Fig. 17

2500x magnification

Sample 7 - left



500R15W473KV4 – pre Temp Humidity

Fig. 18

250x magnification

Sample 7 - right

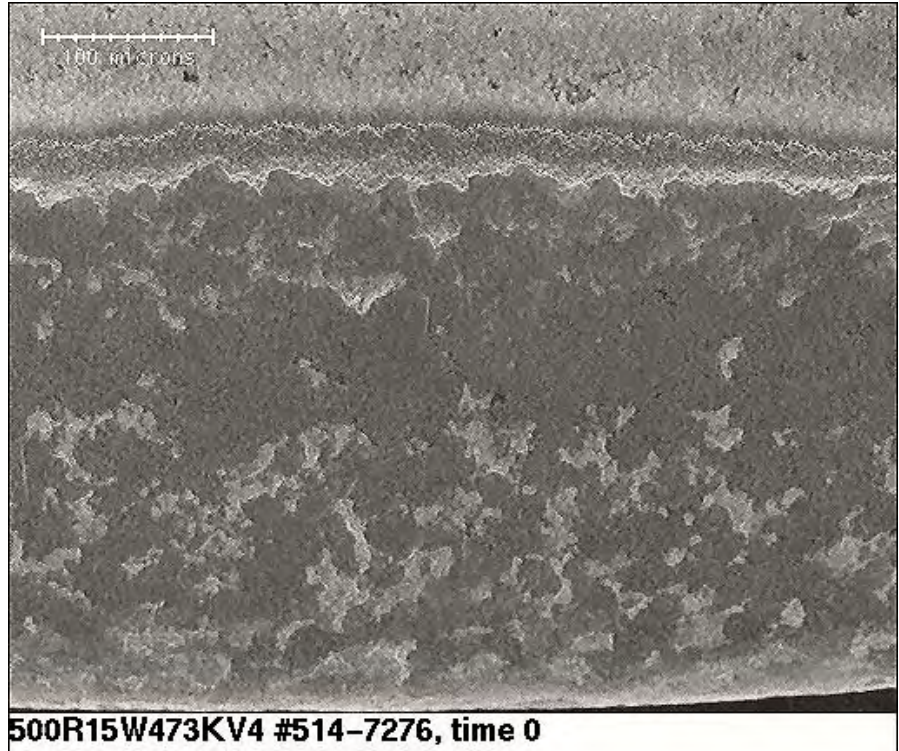
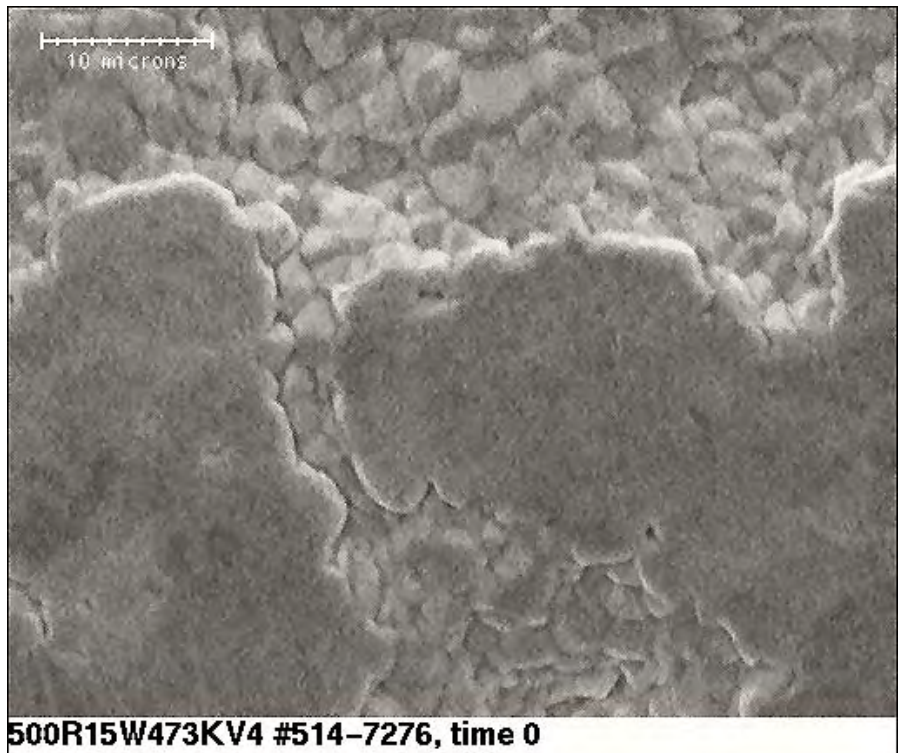


Fig. 19

2500x magnification

Sample 7 - right



500R15W473KV4 – pre Temp Humidity

Fig. 20

250x magnification

Sample 9 - left



Fig. 21

2500x magnification

Sample 9 - left



500R15W473KV4 – pre Temp Humidity

Fig. 22

250x magnification

Sample 9 - right

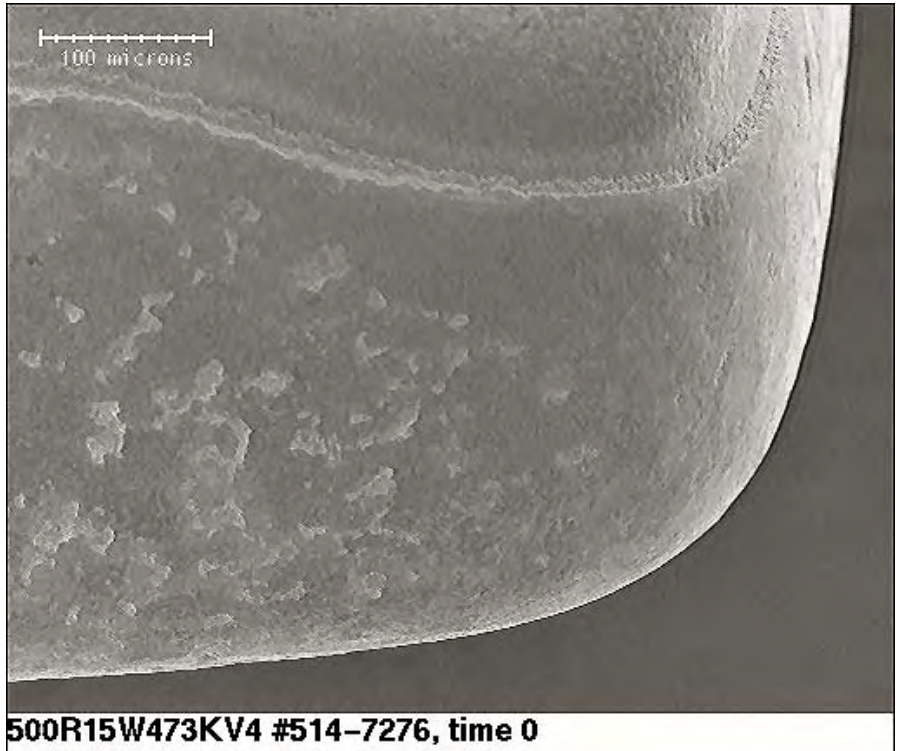
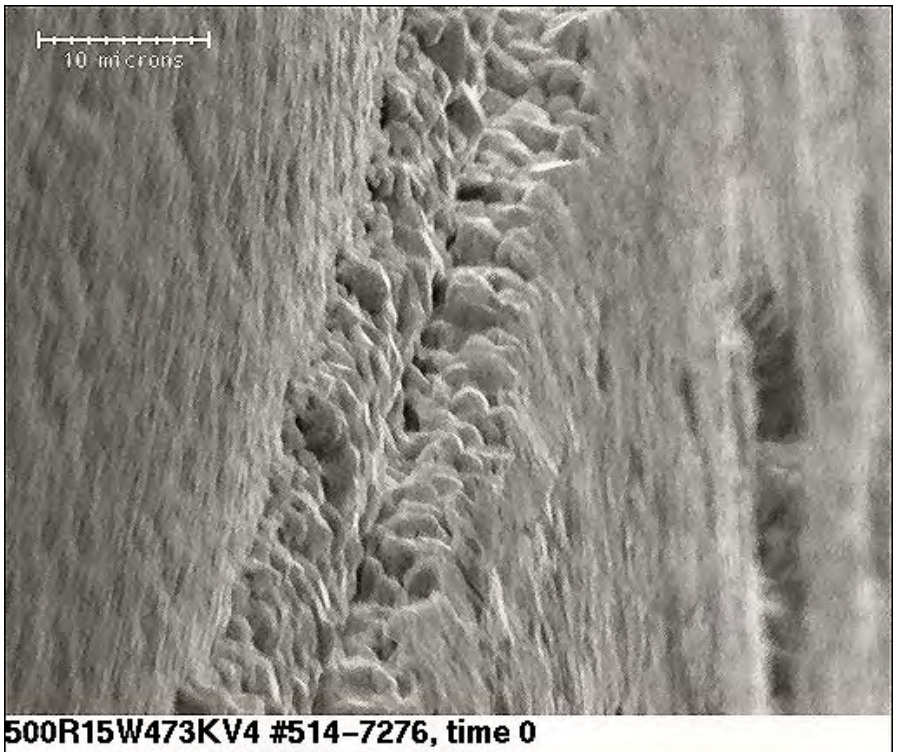


Fig. 23

2500x magnification

Sample 9 - right



500R15W473KV4 – pre Temp Humidity

Fig. 24

250x magnification

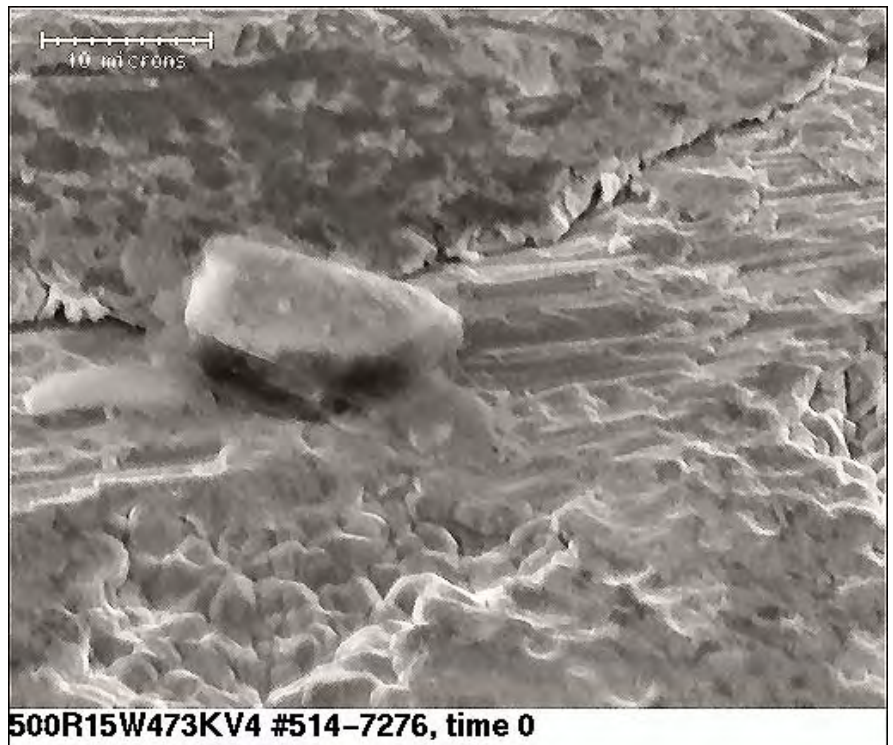
Sample 11 - left



Fig. 25

2500x magnification

Sample 11 - left



500R15W473KV4 – pre Temp Humidity

Fig. 26

250x magnification

Sample 11 - right

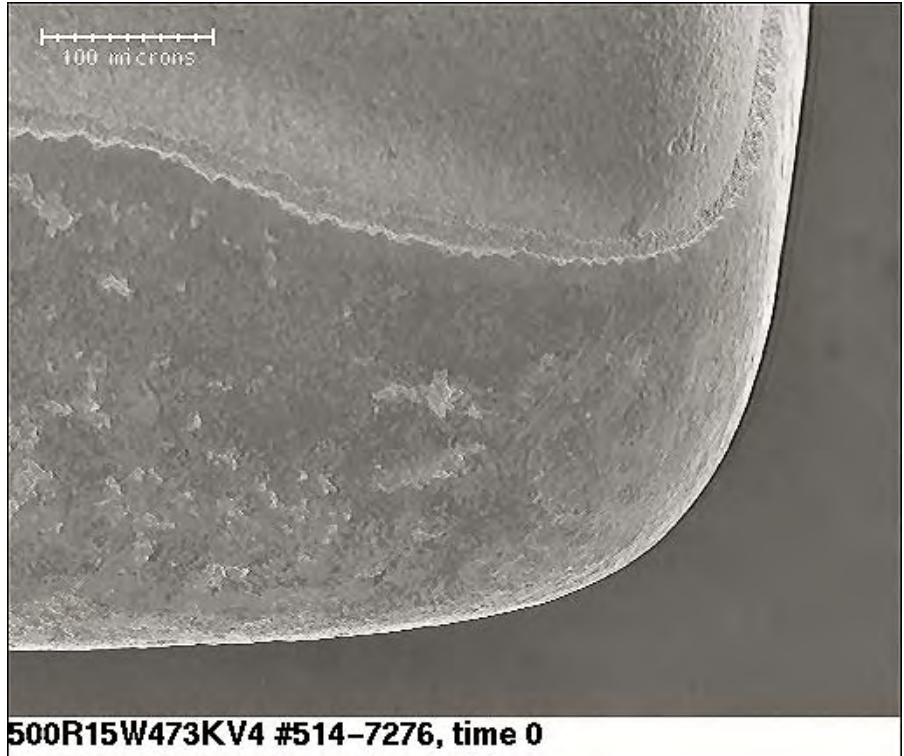
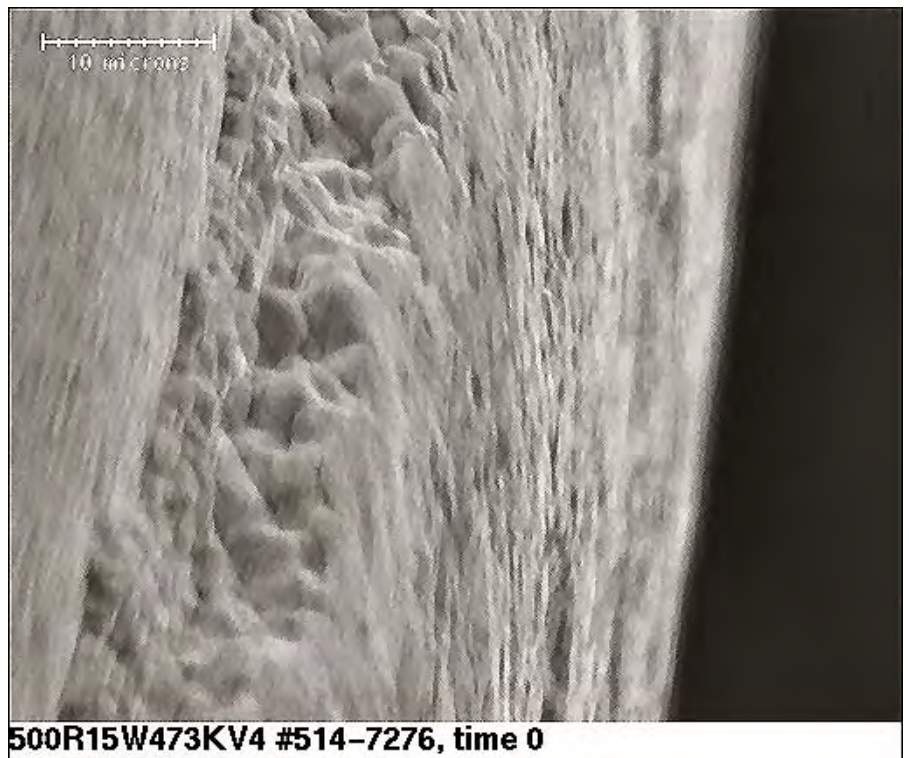


Fig. 27

2500x magnification

Sample 11 - right



500R15W473KV4 – pre Temp Humidity

Fig. 28

250x magnification

Sample 12 - left



Fig. 29

2500x magnification

Sample 12 - left



500R15W473KV4 – pre Temp Humidity

Fig. 30

250x magnification

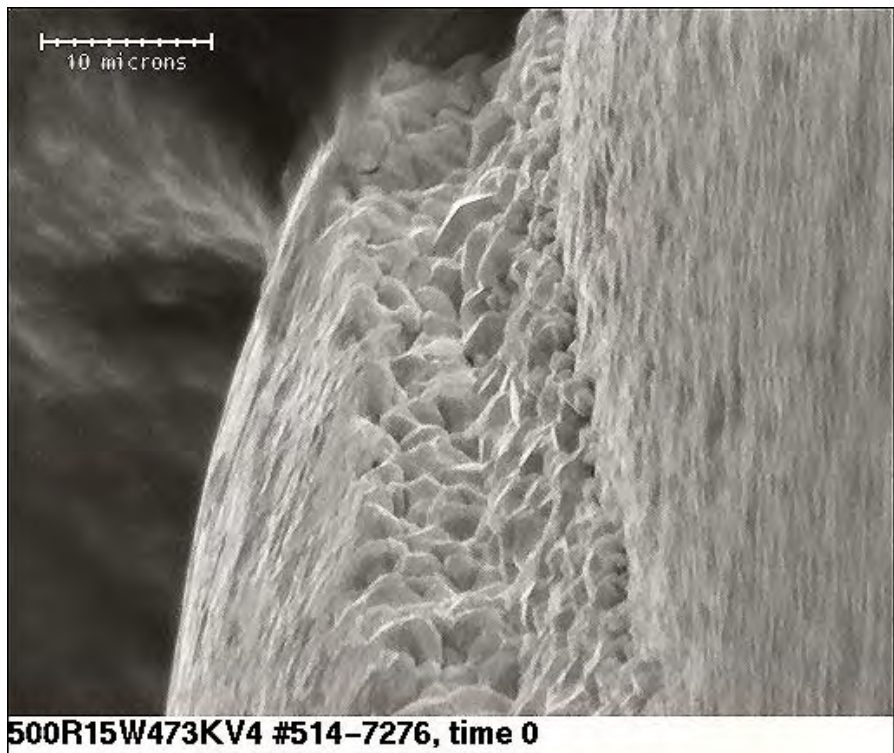
Sample 12 - right



Fig. 31

2500x magnification

Sample 12 - right



500R15W473KV4 – pre Temp Humidity

Fig. 32

250x magnification

Sample 14 - left



Fig. 33

2500x magnification

Sample 14 - left



500R15W473KV4 – pre Temp Humidity

Fig. 34

250x magnification

Sample 14 - right

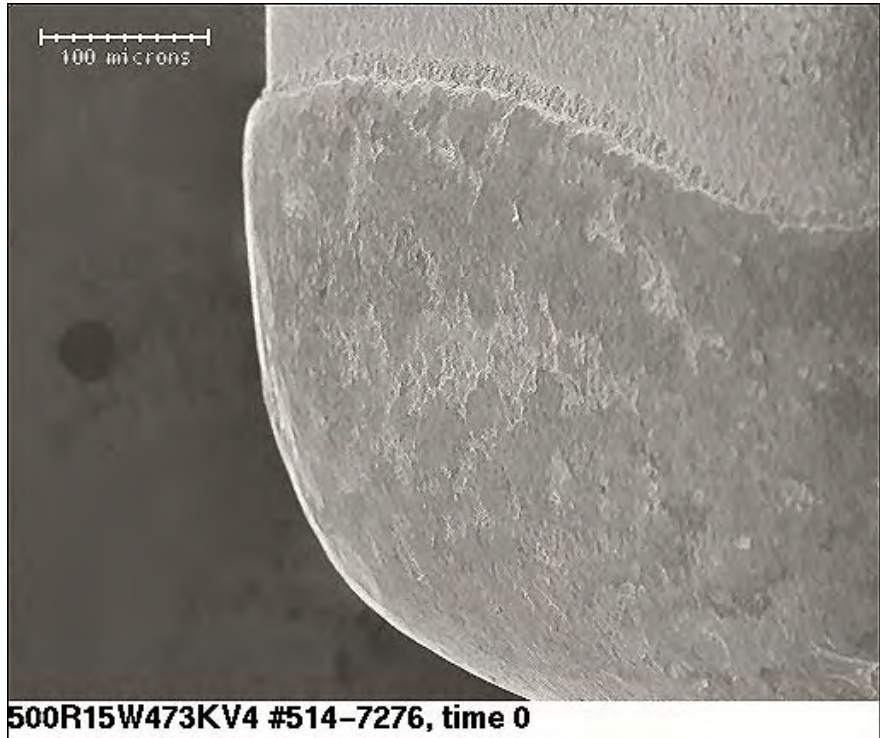


Fig. 35

2500x magnification

Sample 14 - right



500R15W473KV4 – 1000 hours

Fig. 36

250x magnification

Sample 1 - left

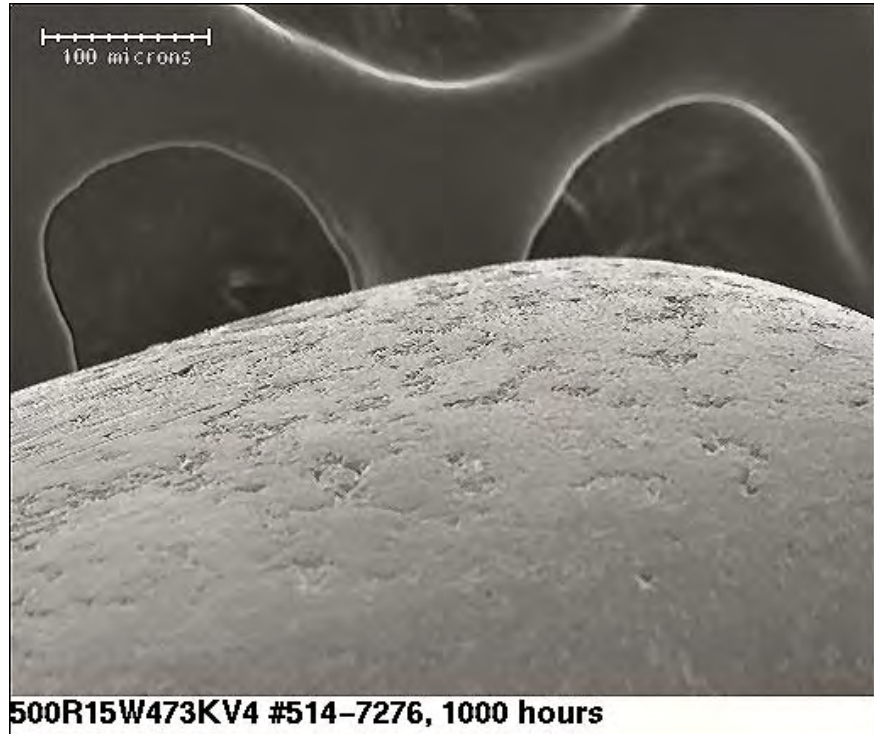
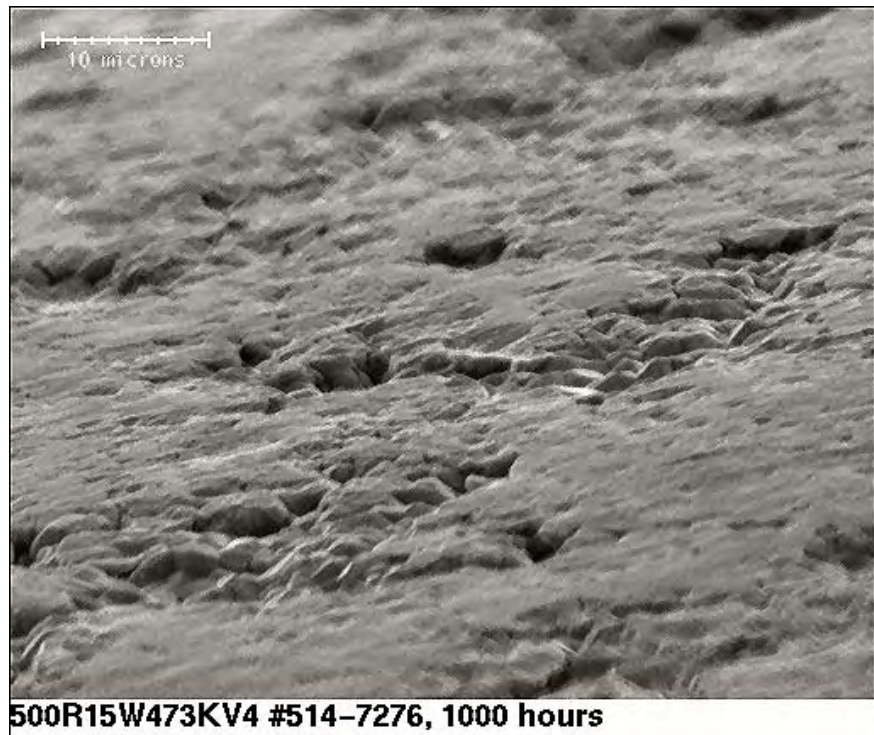


Fig. 37

2500x magnification

Sample 1 -left



500R15W473KV4 – 1000 hours

Fig. 38

250x magnification

Sample 2 - left



Fig. 39

250x magnification

Sample 3 -left



500R15W473KV4 – 1000 hours

Fig. 40

250x magnification

Sample 4 - left

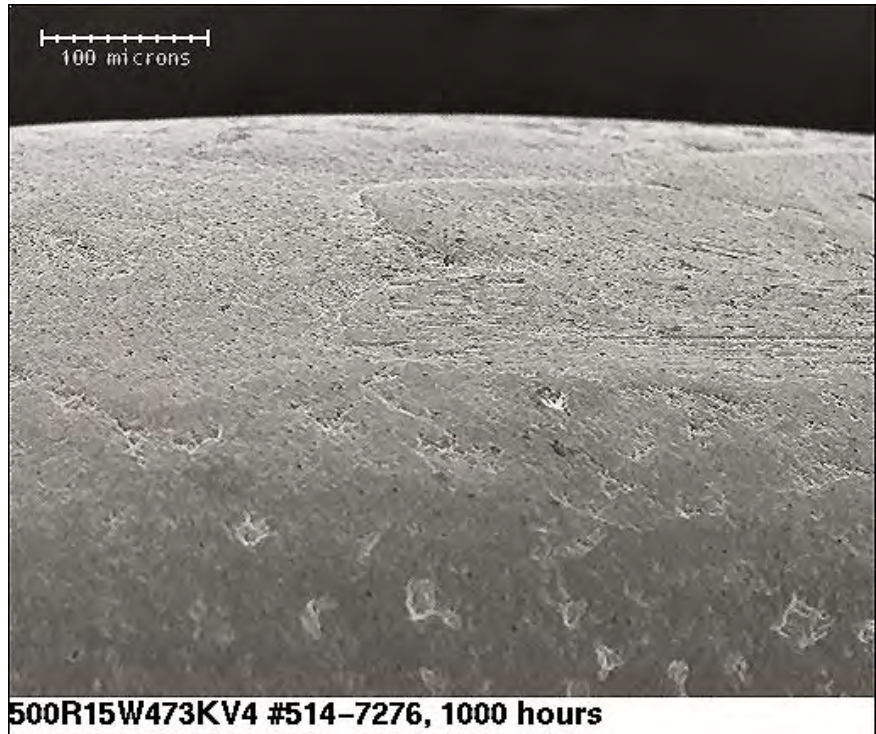
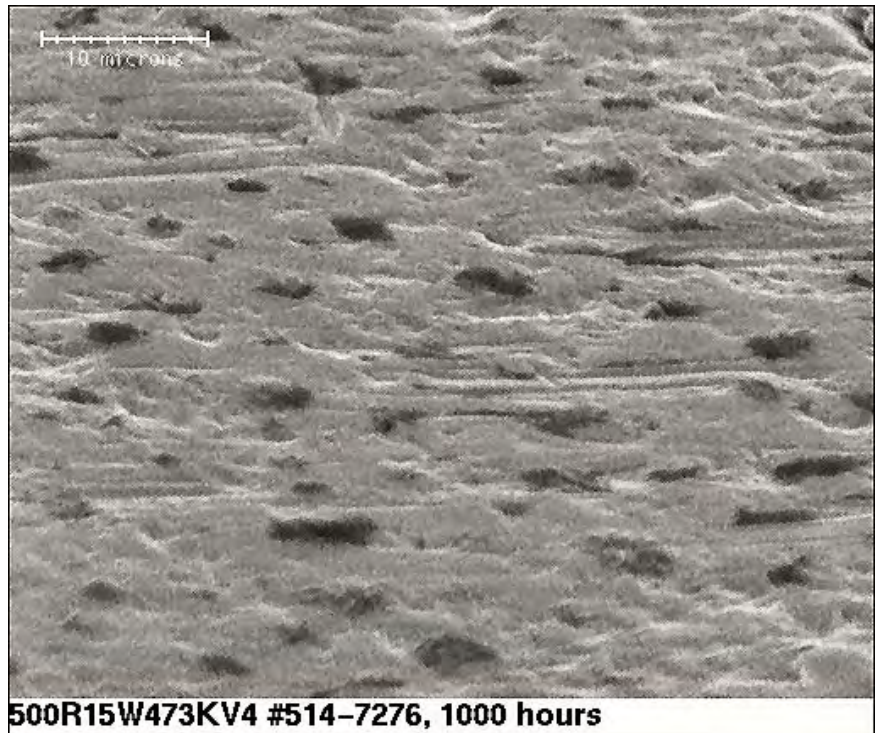


Fig. 41

2500x magnification

Sample 4 - left



500R15W473KV4 – 1000 hours

Fig. 42

250x magnification

Sample 5 - left

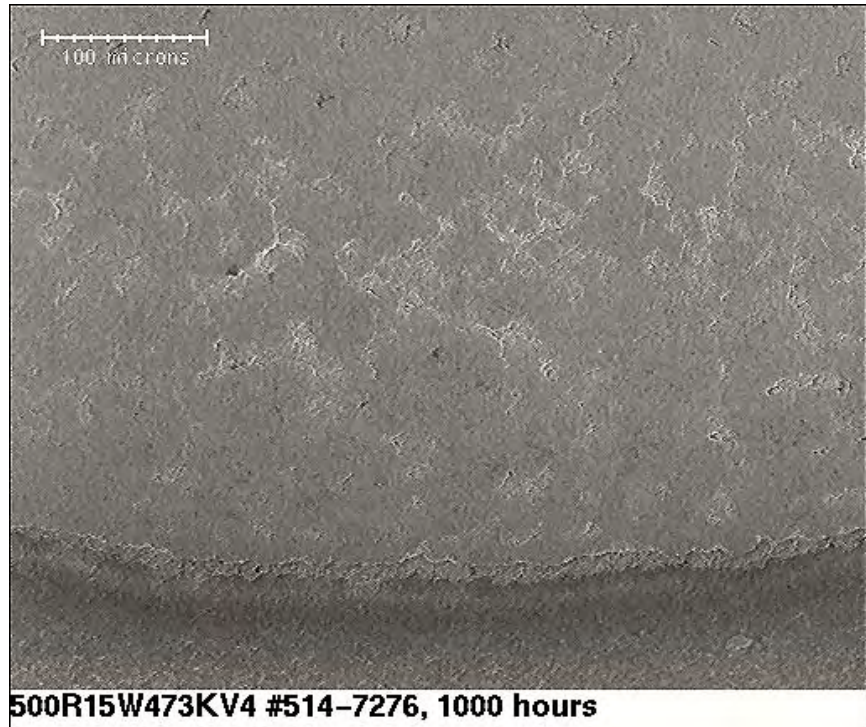
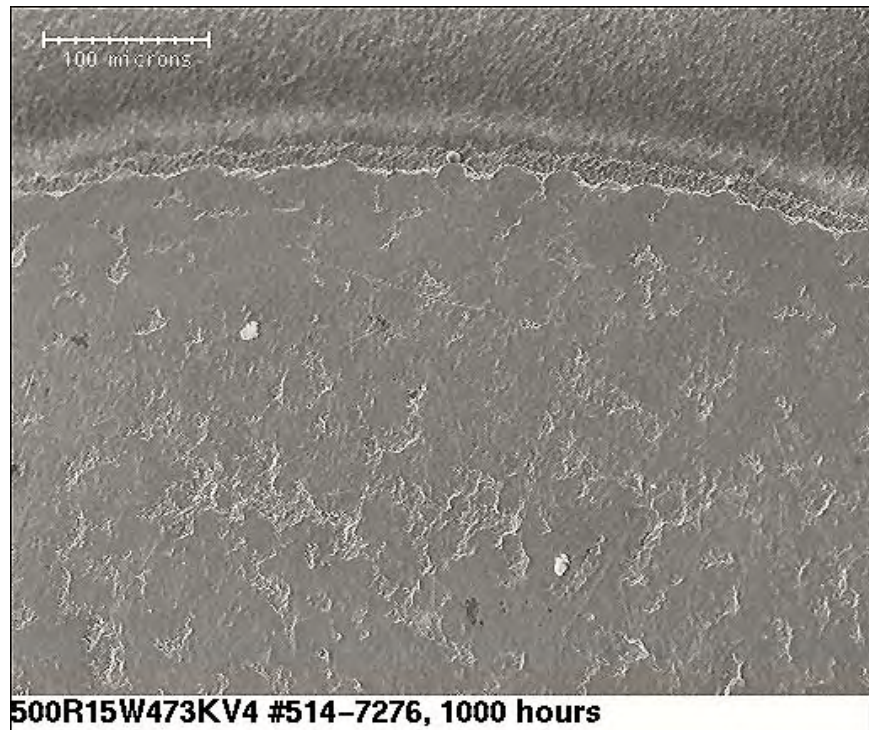


Fig. 43

250x magnification

Sample 6 - right



500R15W473KV4 – 1000 hours

Fig. 44

250x magnification

Sample 6 - left



Fig. 45

2500x magnification

Sample 6 -left



500R15W473KV4 – 1000 hours

Fig. 46

250x magnification

Sample 7 - left

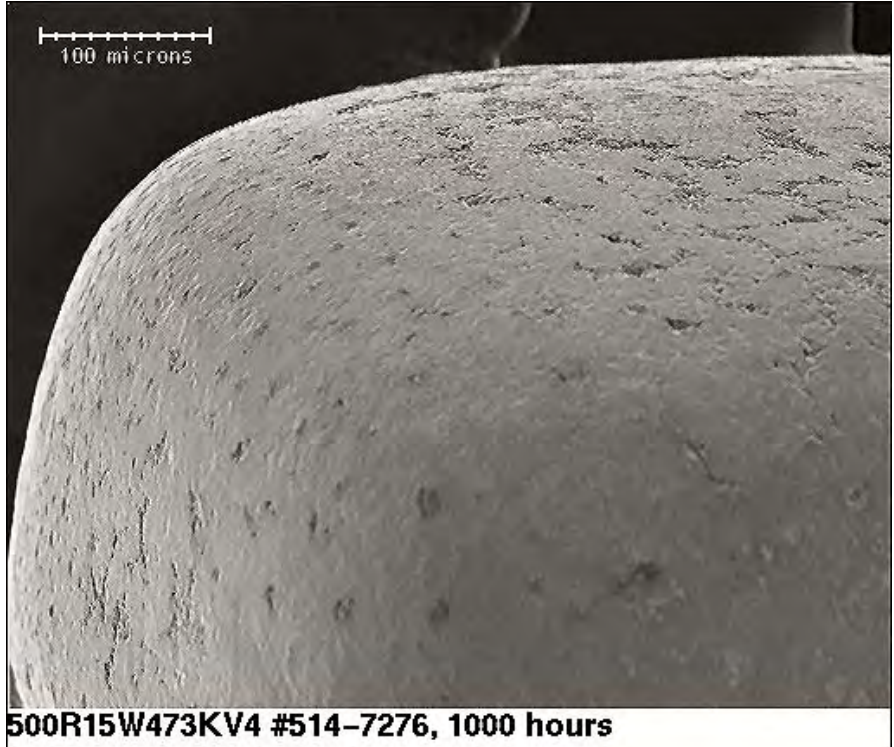
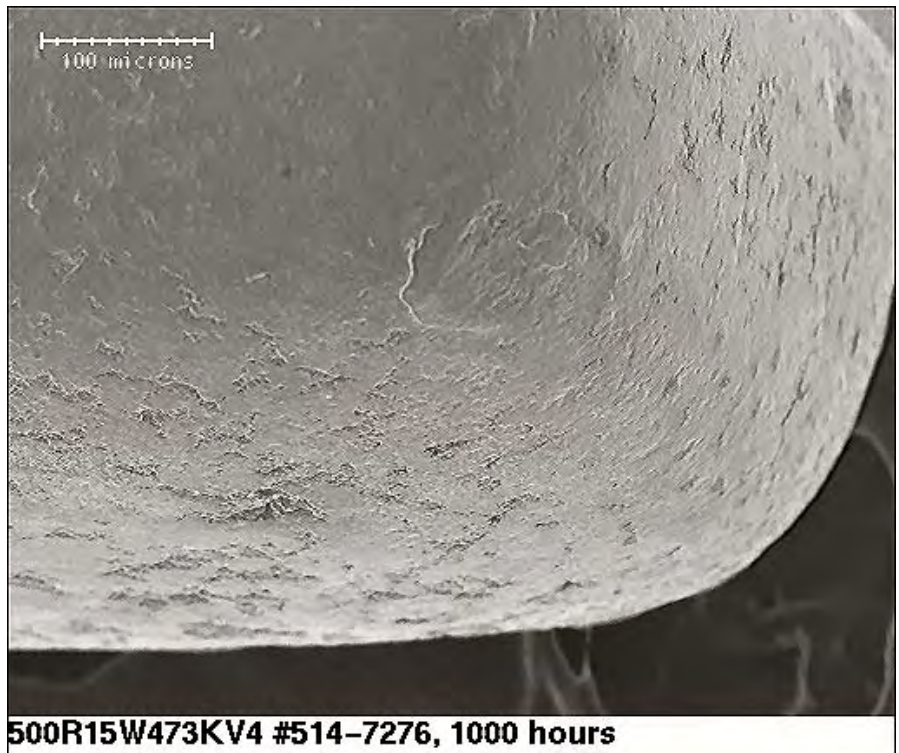


Fig. 47

250x magnification

Sample 7 -right



500R15W473KV4 – 1000 hours

Fig. 48

250x magnification

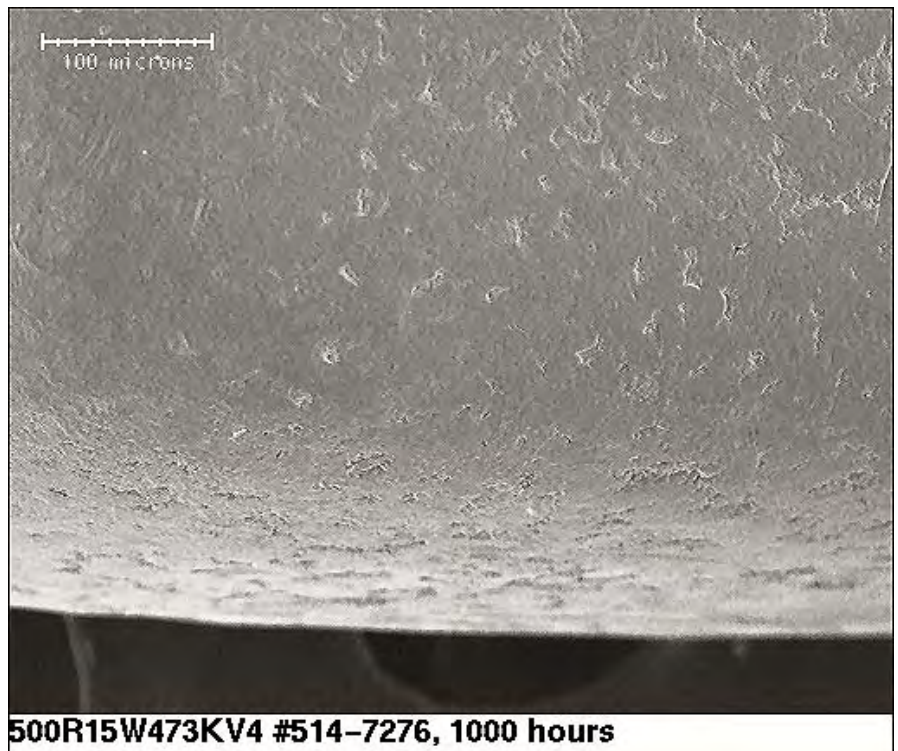
Sample 9 - left



Fig. 49

250x magnification

Sample 9 -right



500R15W473KV4 – 1000 hours

Fig. 50

250x magnification

Sample 10 - right

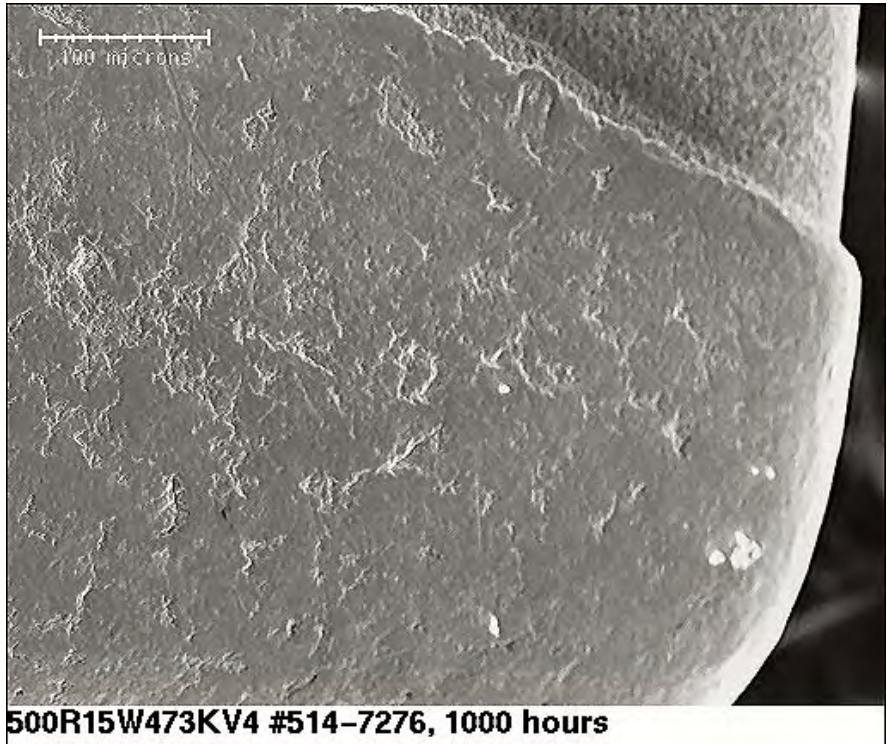
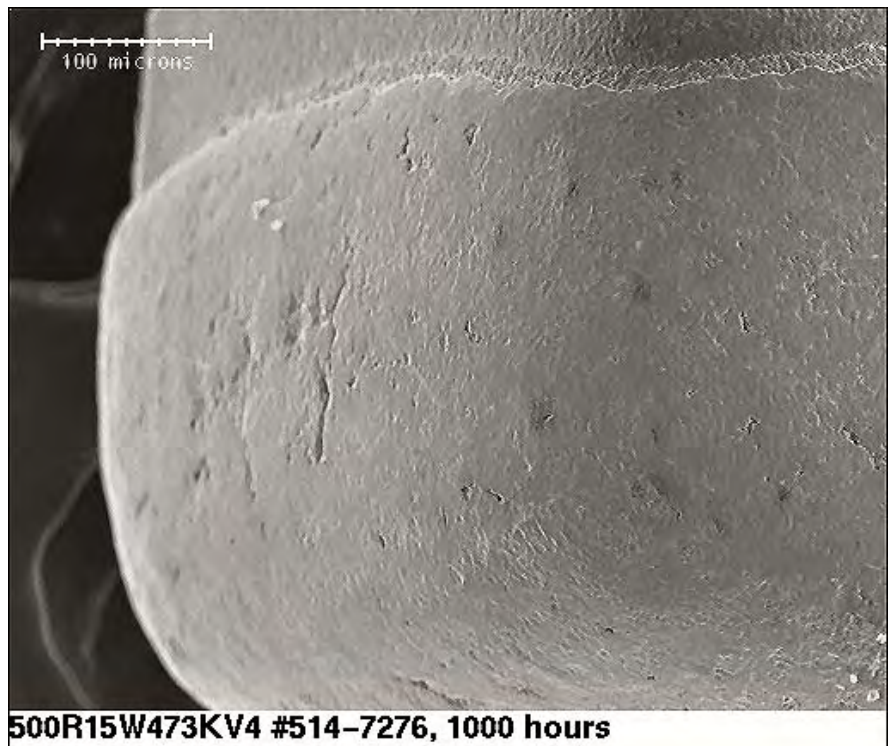


Fig. 51

250x magnification

Sample 11 -right



500R15W473KV4 – 1000 hours

Fig. 52

250x magnification

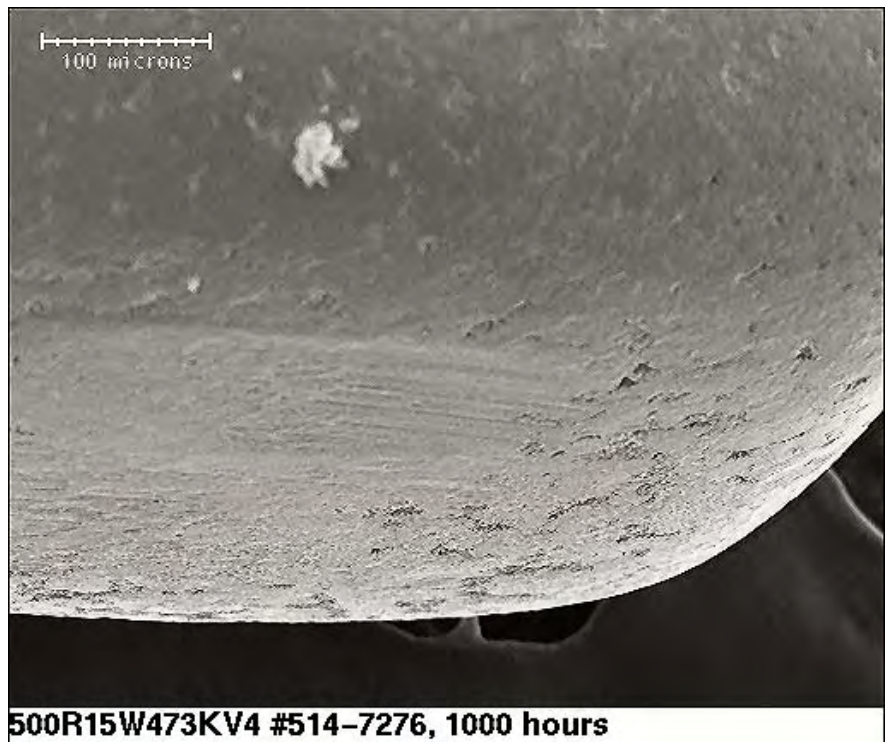
Sample 12 - right



Fig. 53

250x magnification

Sample 13 -right

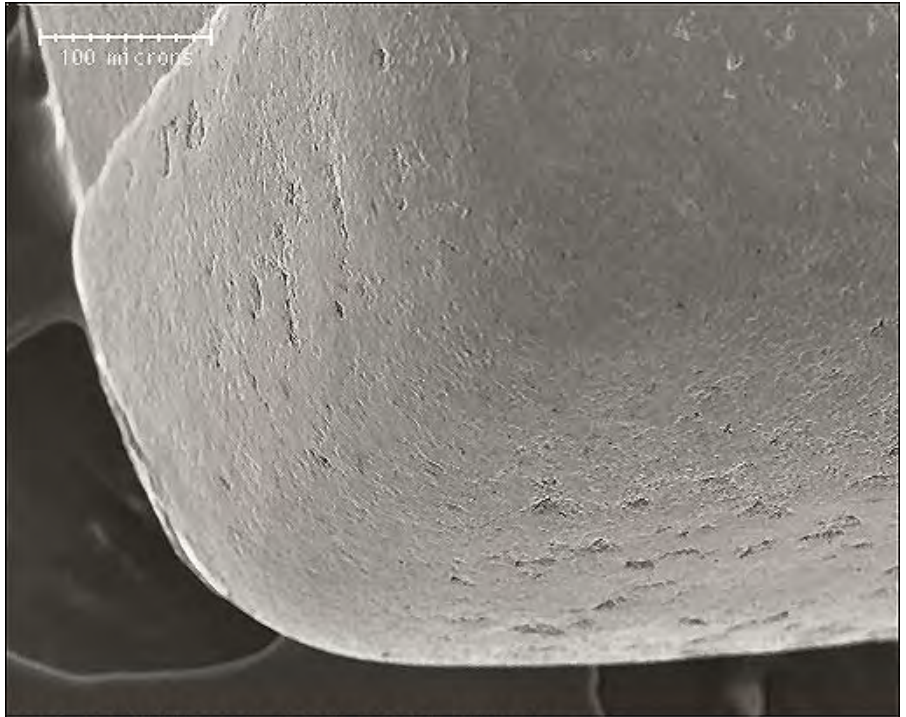


500R15W473KV4 – 1000 hours

Fig. 54

250x magnification

Sample 14 - right



500R15W473KV4 #514-7276, 1000 hours

Fig. 55

1000x magnification

Sample 15 - right



500R15W473KV4 #514-7276, 1000 hours

500R15W473KV4 – 4000 hours

Fig. 56

250x magnification

Sample 1 - left



Fig. 57

1000x magnification

Sample 1 - left



500R15W473KV4 – 4000 hours

Fig. 58

250x magnification

Sample 1 - right

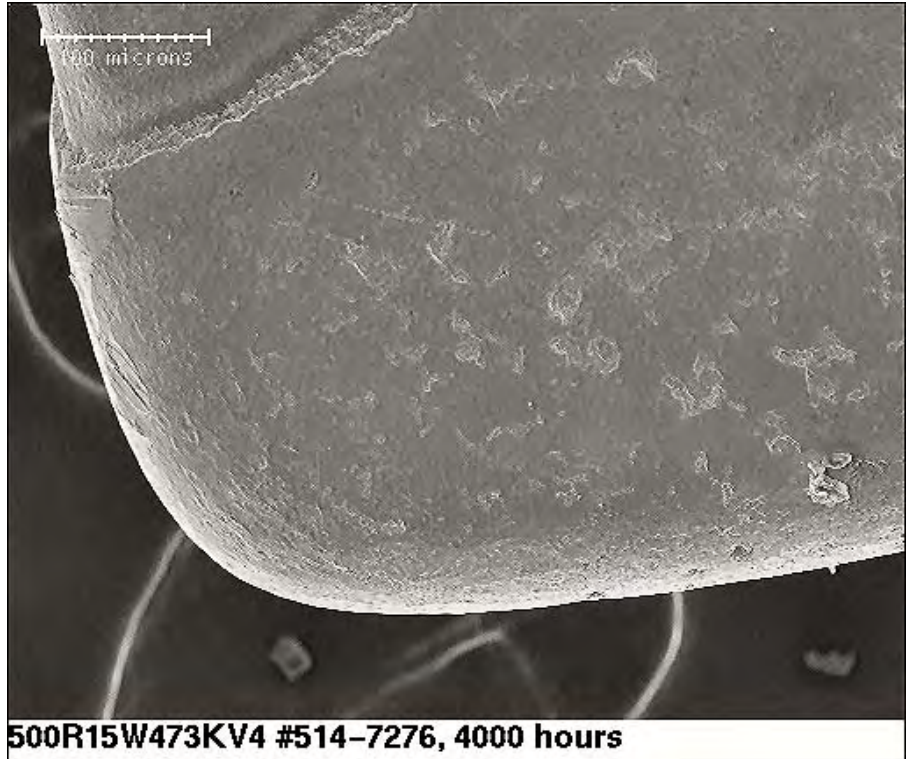
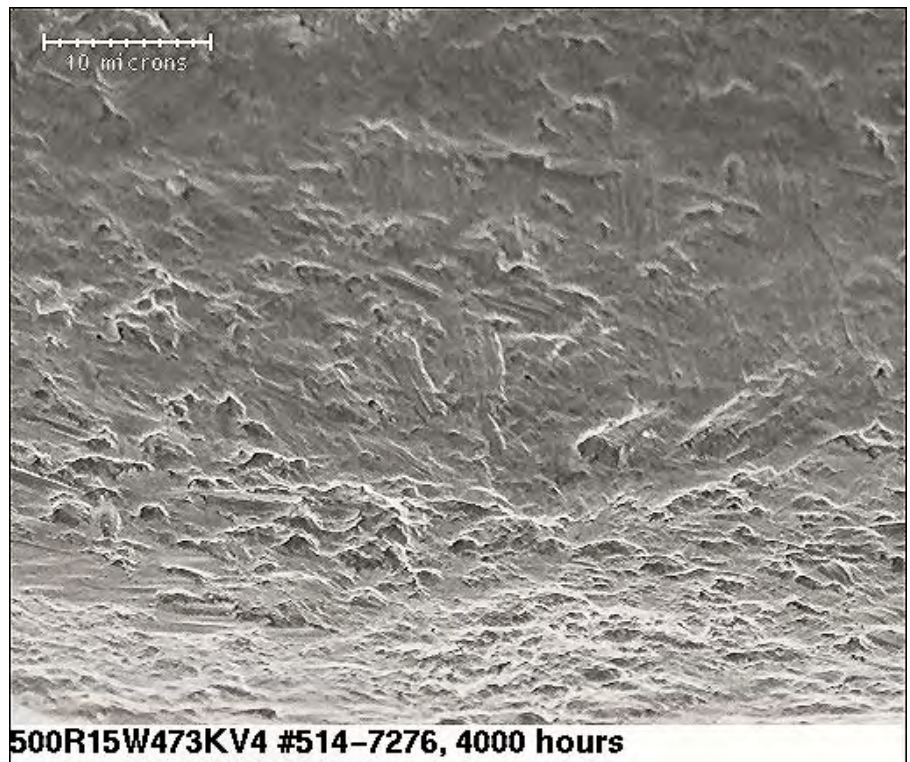


Fig. 59

1000x magnification

Sample 1 - right



500R15W473KV4 – 4000 hours

Fig. 60

250x magnification

Sample 2 - left

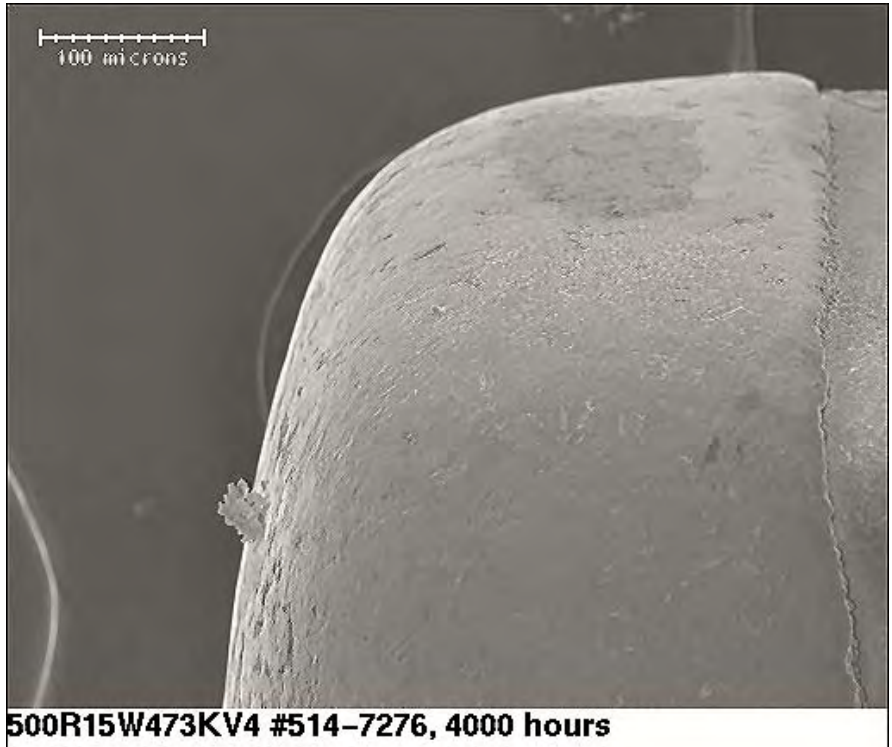
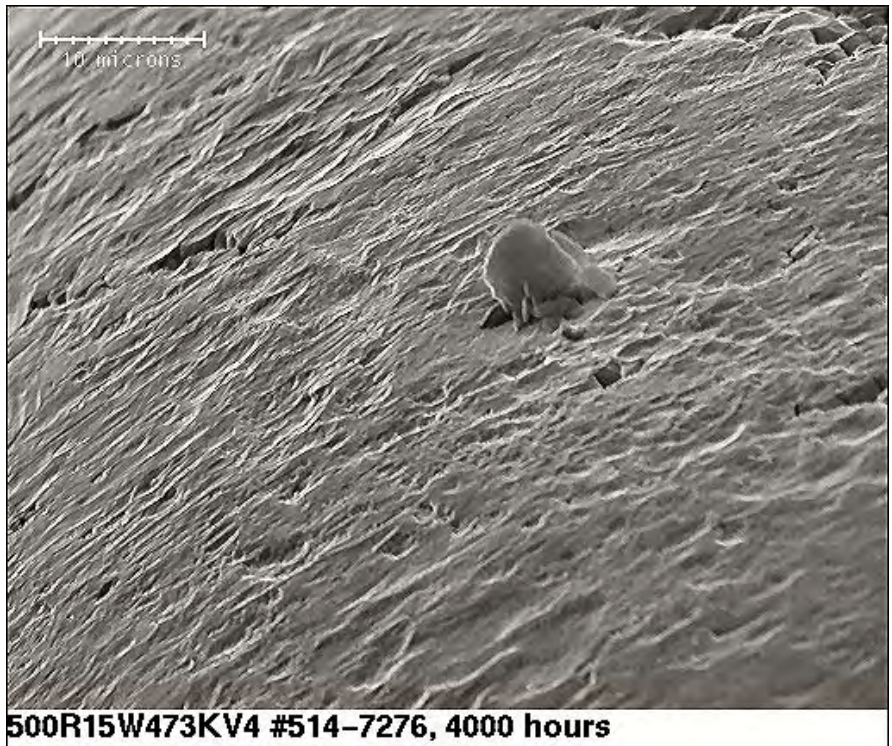


Fig. 61

2500x magnification

Sample 2 - left



500R15W473KV4 – 4000 hours

Fig. 62

250x magnification

Sample 2 - right

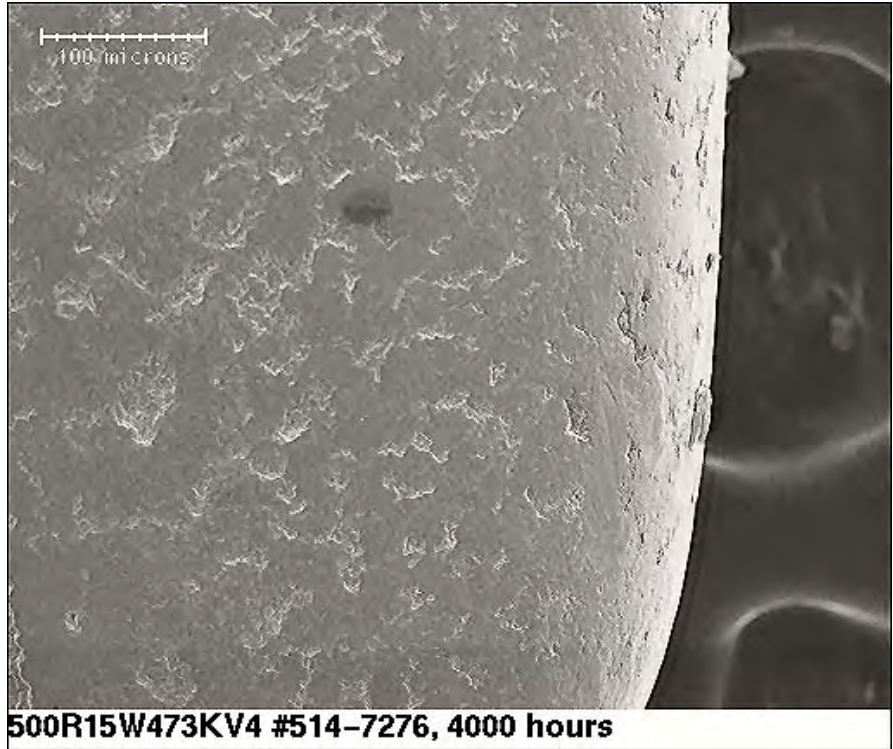
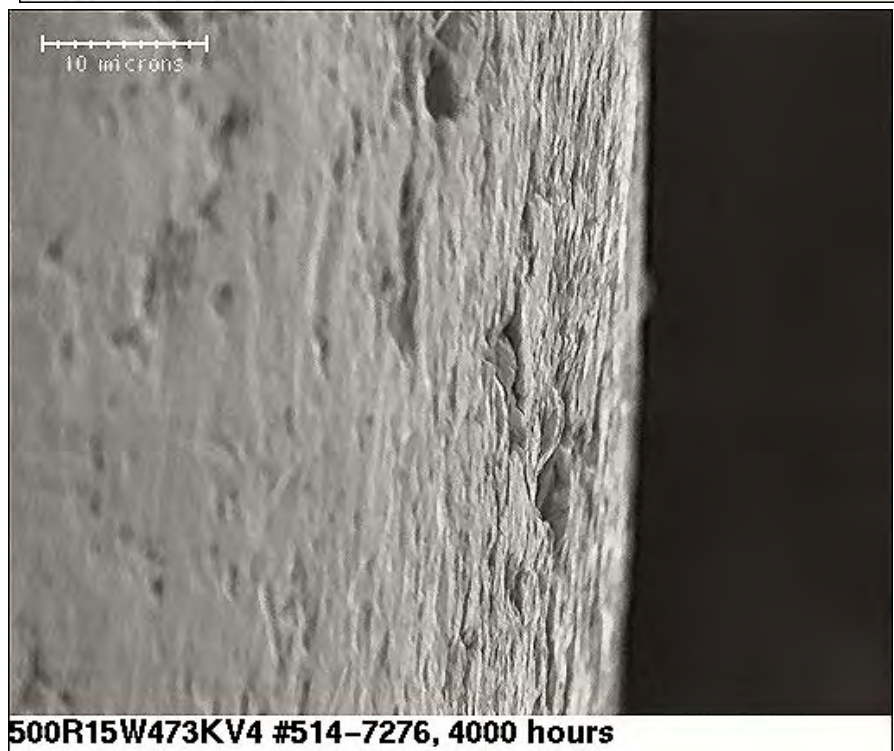


Fig. 63

2500x magnification

Sample 2 - right



500R15W473KV4 – 4000 hours

Fig. 64

250x magnification

Sample 3 - left

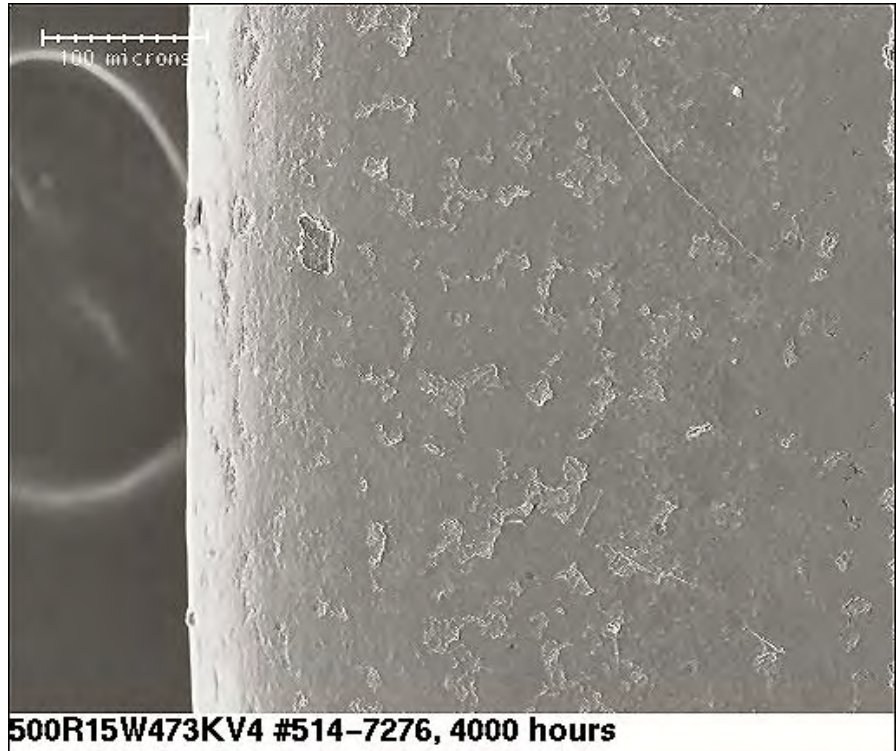


Fig. 65

2500x magnification

Sample 3 - left



500R15W473KV4 – 4000 hours

Fig. 66

250x magnification

Sample 3 - right

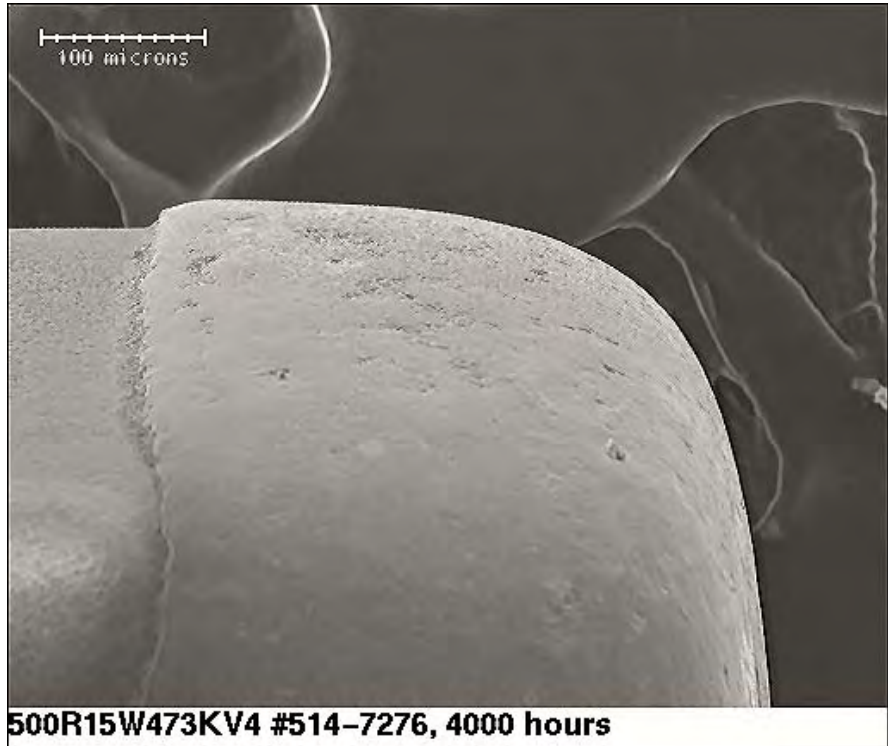
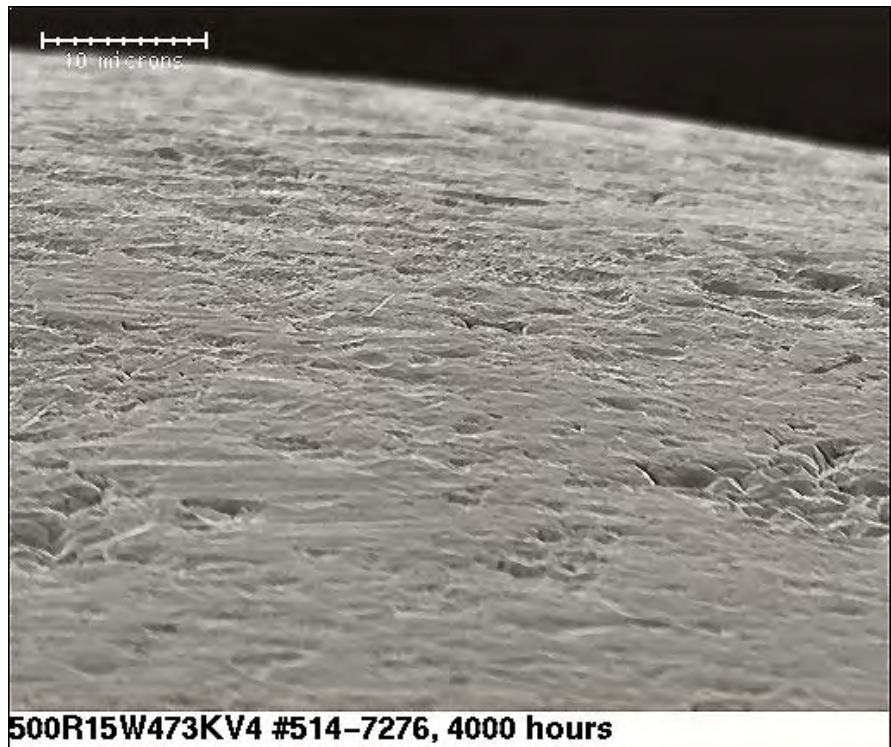


Fig. 67

2500x magnification

Sample 3 - right

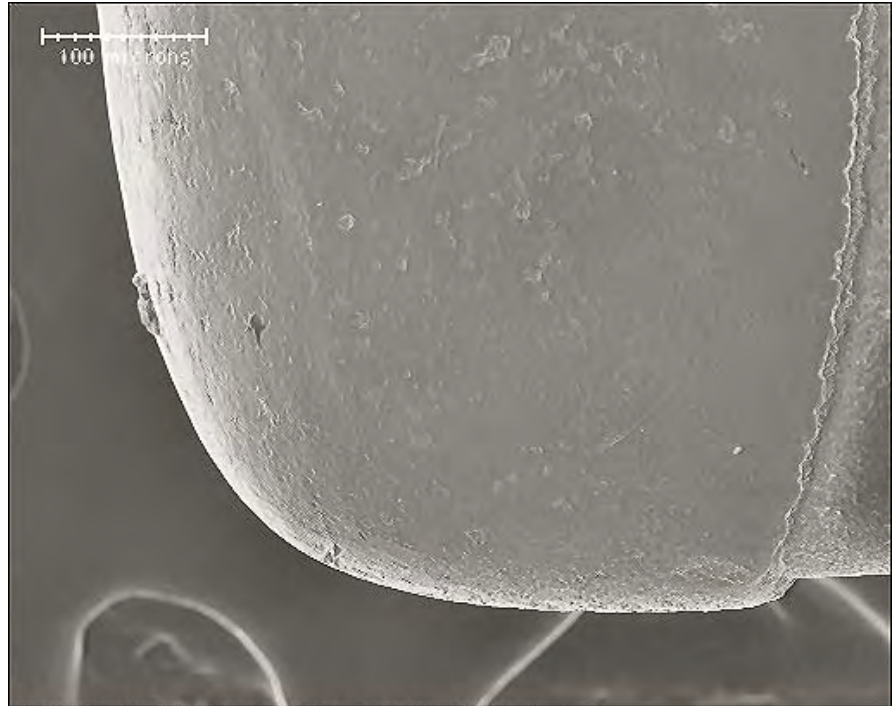


500R15W473KV4 – 4000 hours

Fig. 68

250x magnification

Sample 4 - left

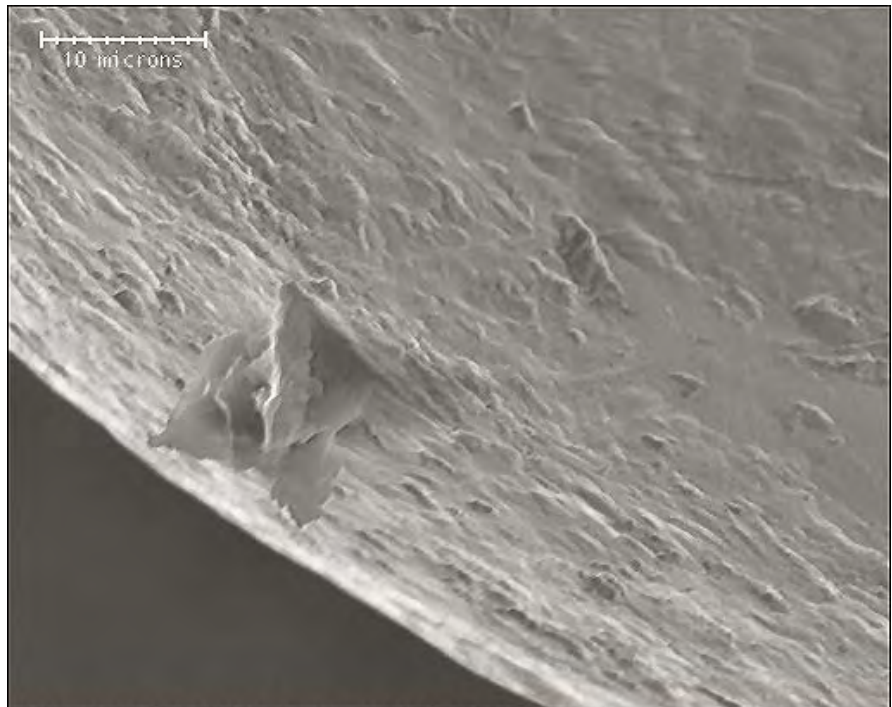


500R15W473KV4 #514-7276, 4000 hours

Fig. 69

2500x magnification

Sample 4 - left



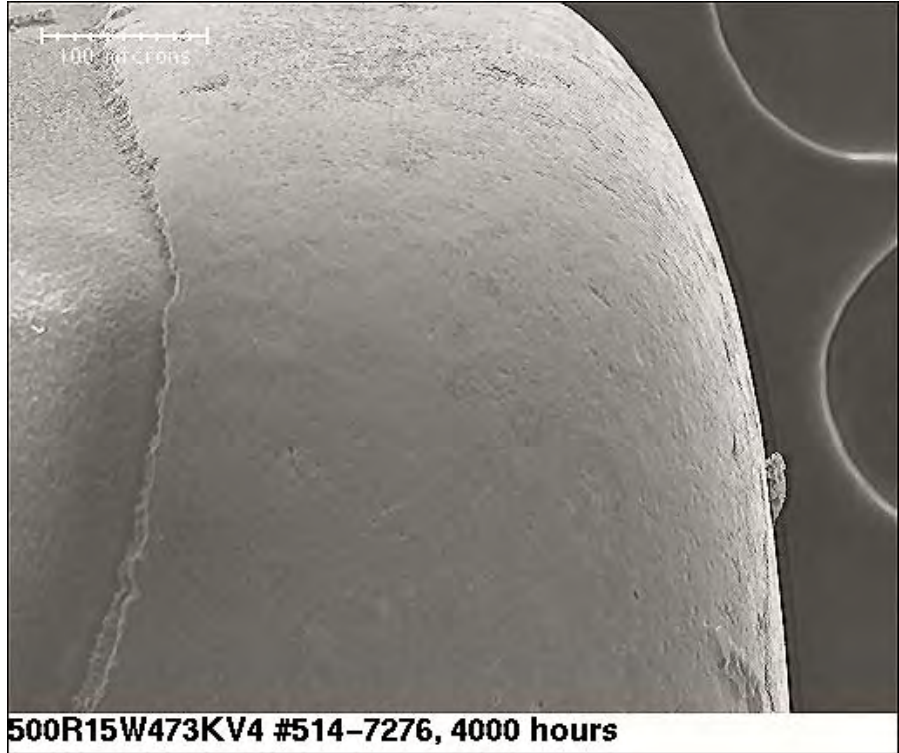
500R15W473KV4 #514-7276, 4000 hours

500R15W473KV4 – 4000 hours

Fig. 70

250x magnification

Sample 4 - right

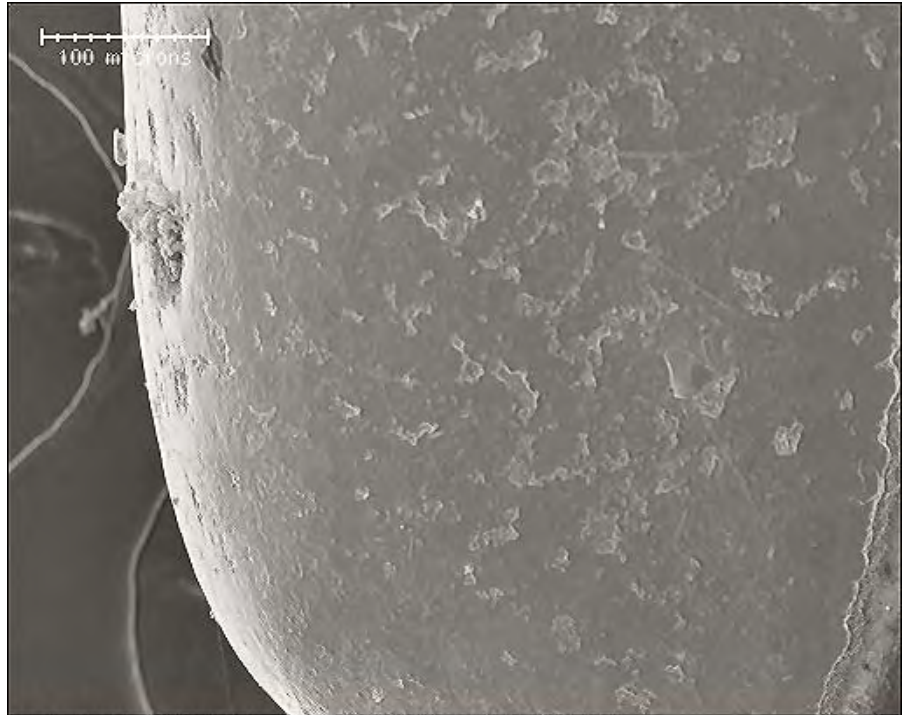


500R15W473KV4 – 4000 hours

Fig. 71

250x magnification

Sample 5 - left



500R15W473KV4 #514-7276, 4000 hours

Fig. 72

2500x magnification

Sample 5 - left



500R15W473KV4 #514-7276, 4000 hours

500R15W473KV4 – 4000 hours

Fig. 73

250x magnification

Sample 5 - right

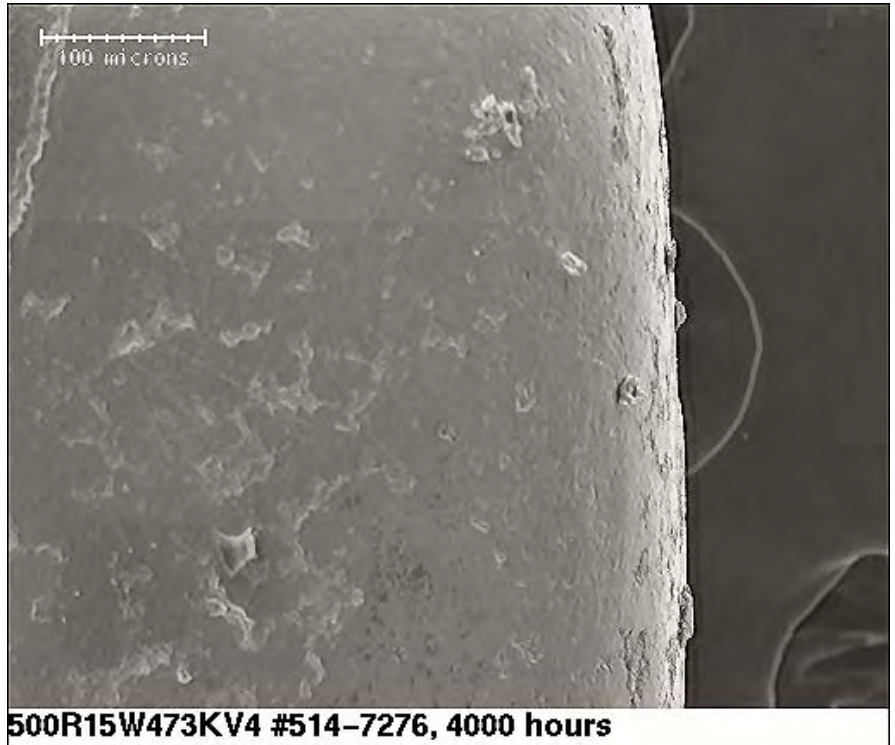
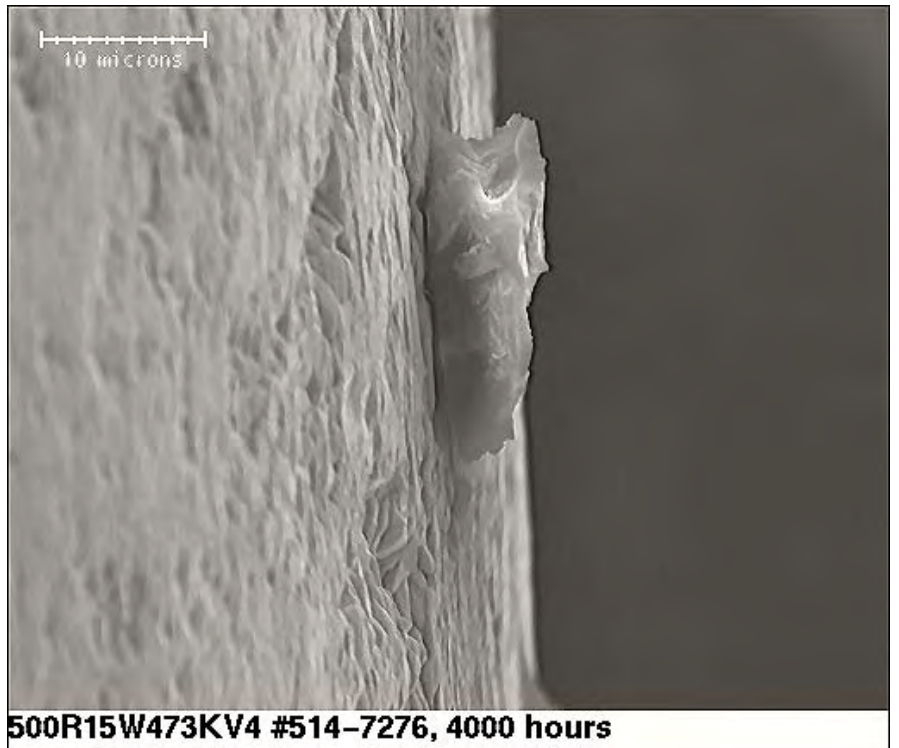


Fig. 74

2500x magnification

Sample 5 - right



500R15W473KV4 – 4000 hours

Fig. 75

250x magnification

Sample 6 - left

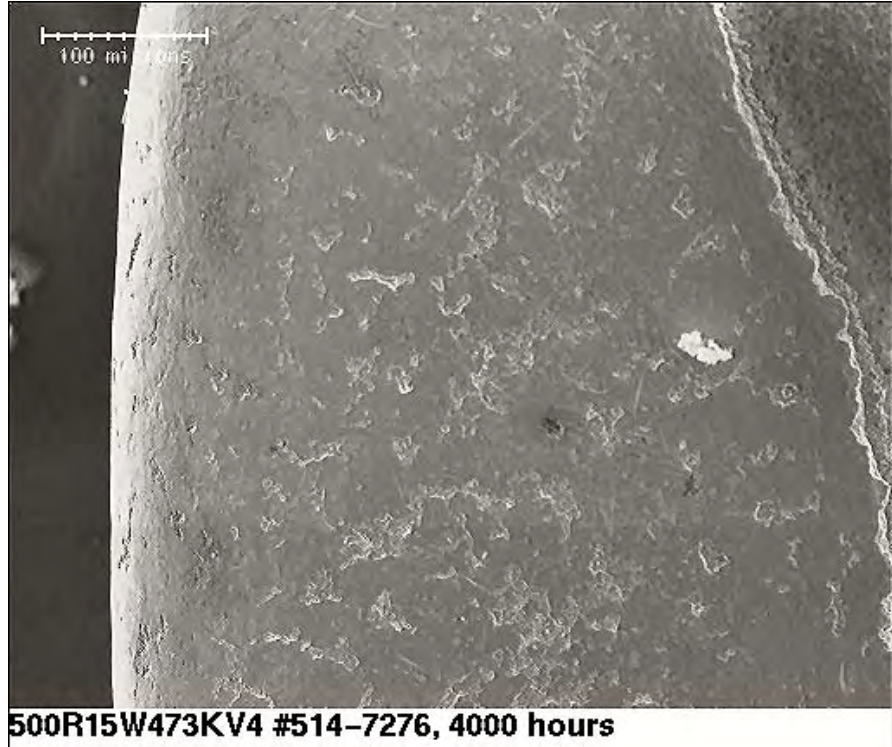
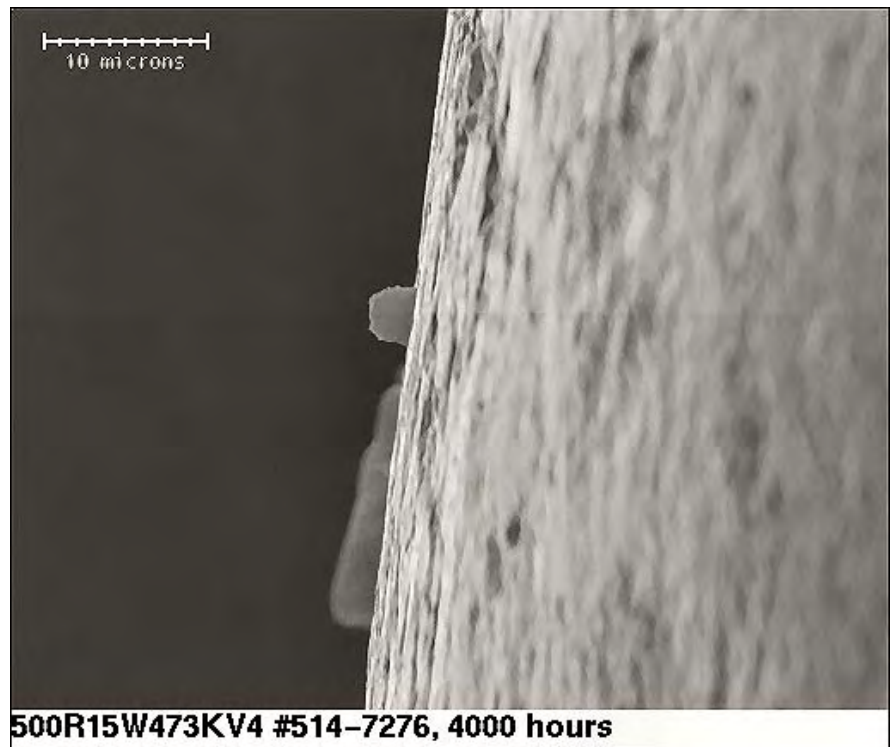


Fig. 76

2500x magnification

Sample 6 - left



500R15W473KV4 – 4000 hours

Fig. 77

250x magnification

Sample 6 - right

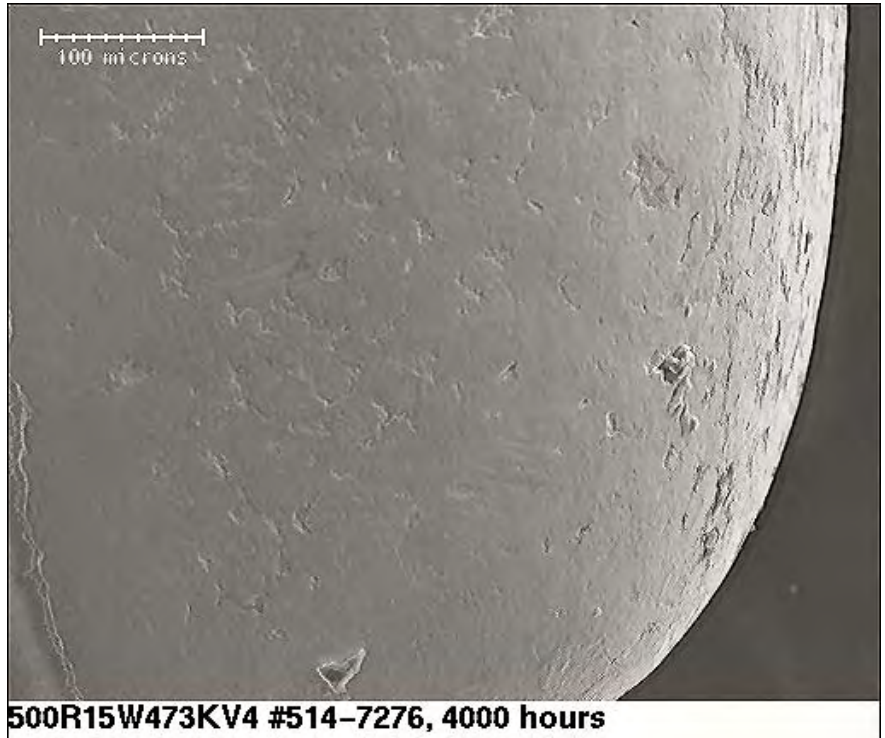
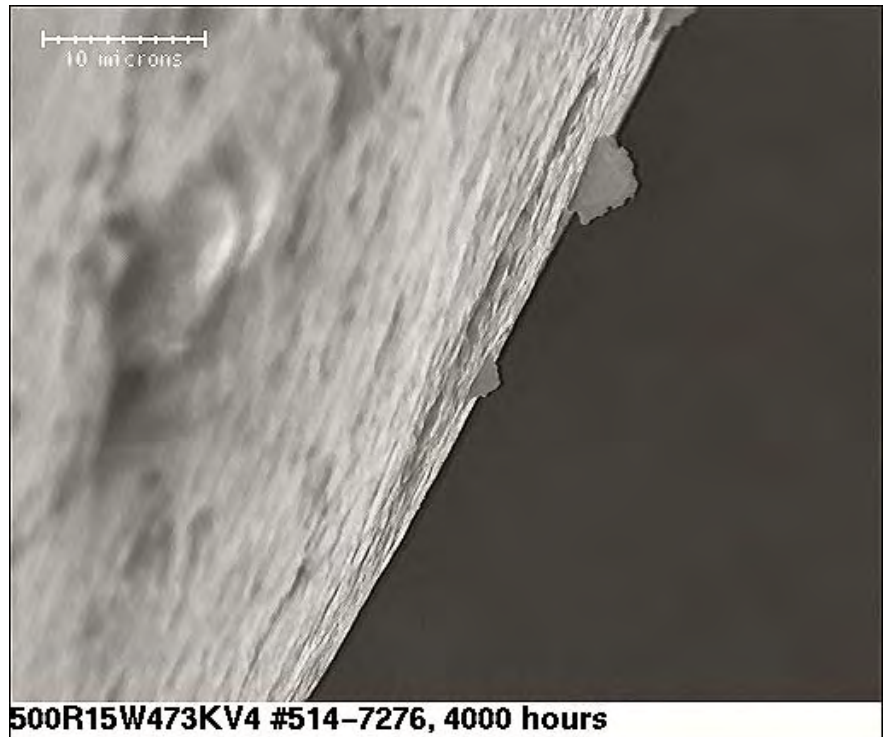


Fig. 78

2500x magnification

Sample 6 - right



500R15W473KV4 – 4000 hours

Fig. 79

250x magnification

Sample 7 - left



Fig. 80

2500x magnification

Sample 7 - left



500R15W473KV4 – 4000 hours

Fig. 81

250x magnification

Sample 7 - right

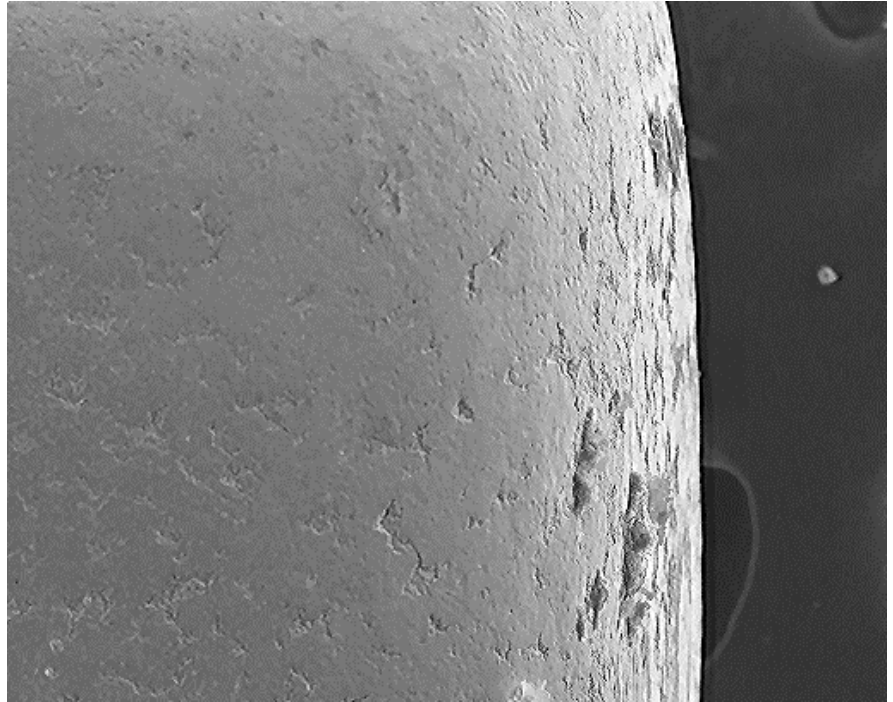
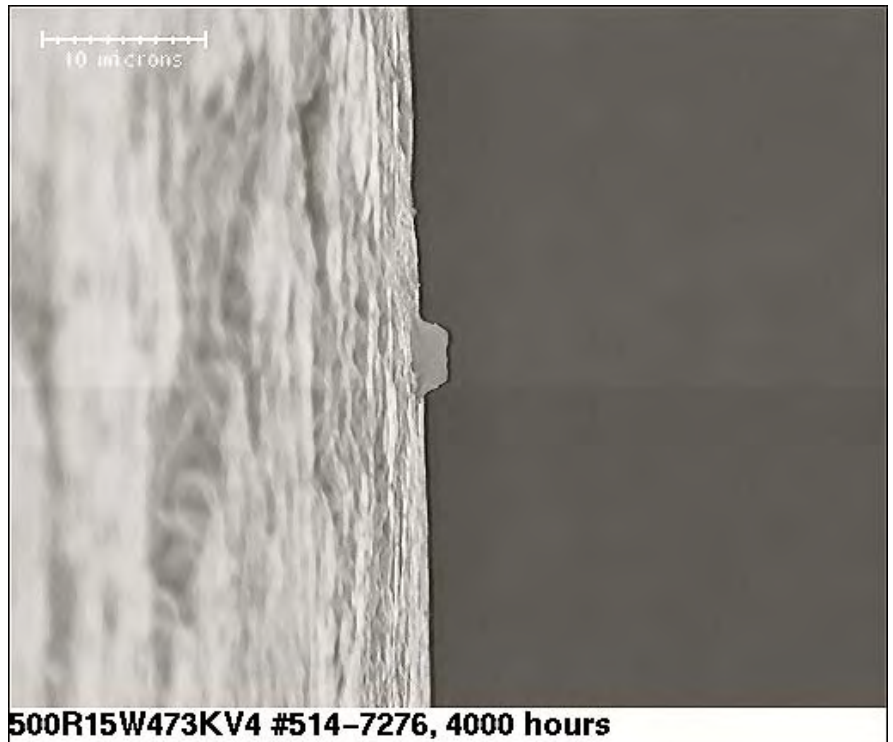


Fig. 82

2500x magnification

Sample 7 - right



500R15W473KV4 – 4000 hours

Fig. 83

250x magnification

Sample 8 - left

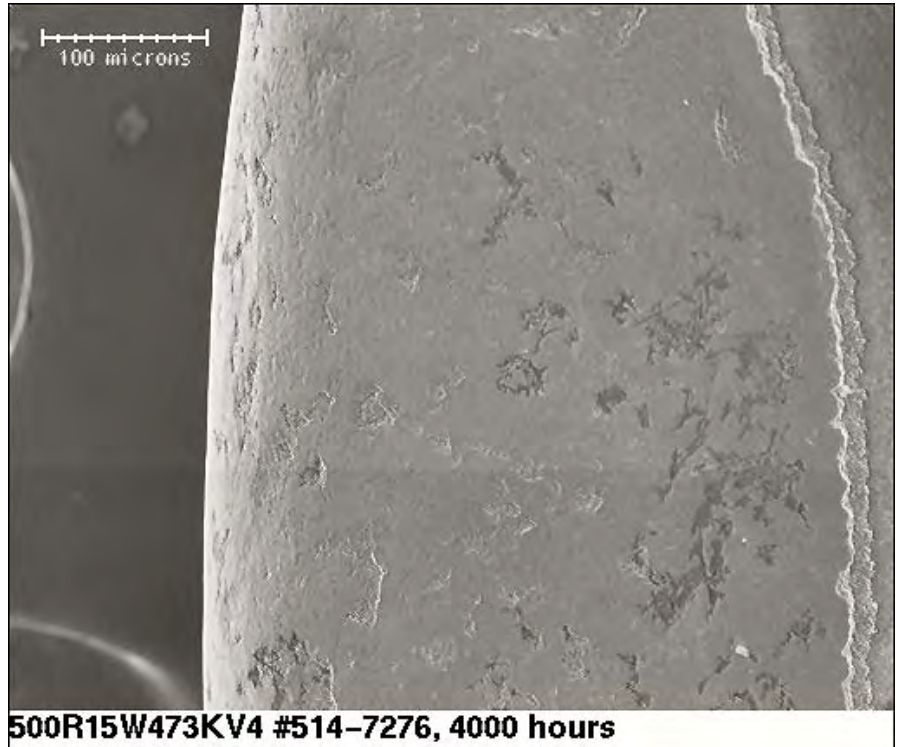
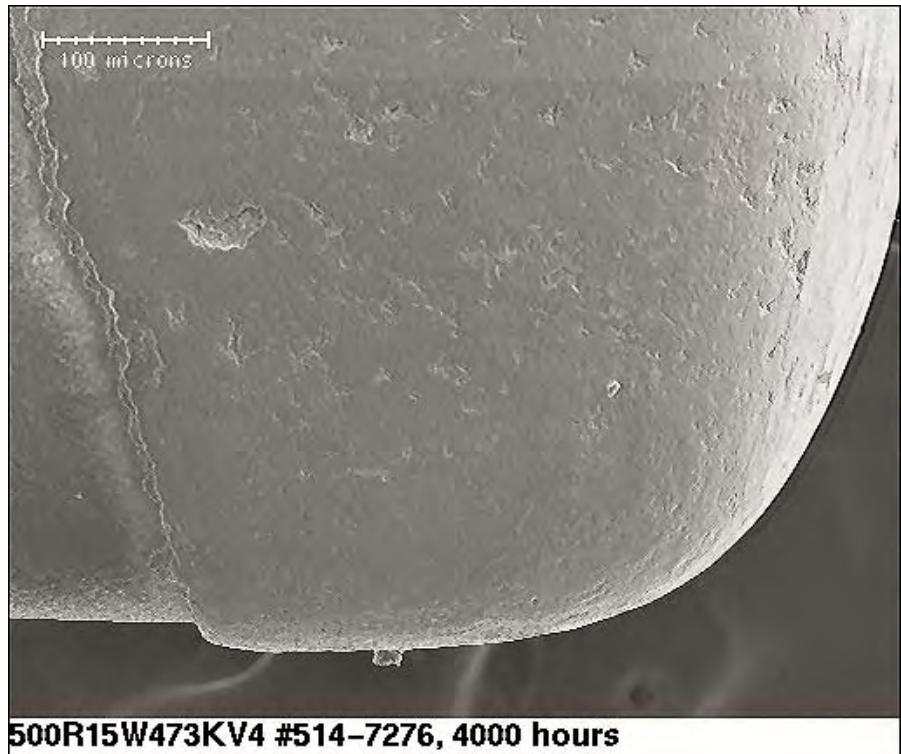


Fig. 84

250x magnification

Sample 8 - right



500R15W473KV4 – 4000 hours

Fig. 85

250x magnification

Sample 9 - right

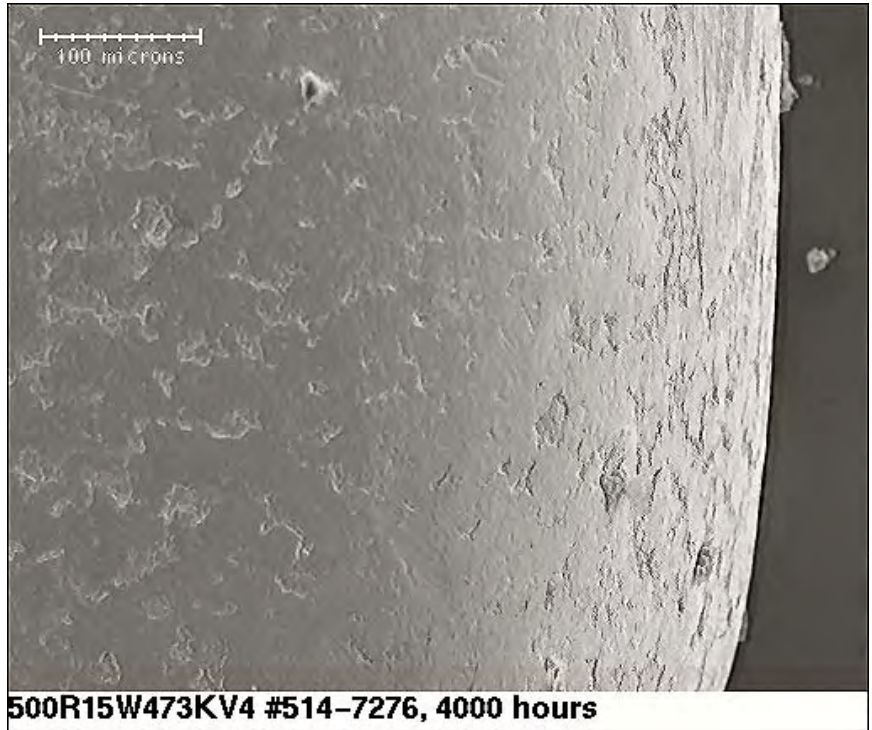


Fig. 86

1000x magnification

Sample 9 - right



500R15W473KV4 – 4000 hours

Fig. 87

250x magnification

Sample 9 - left

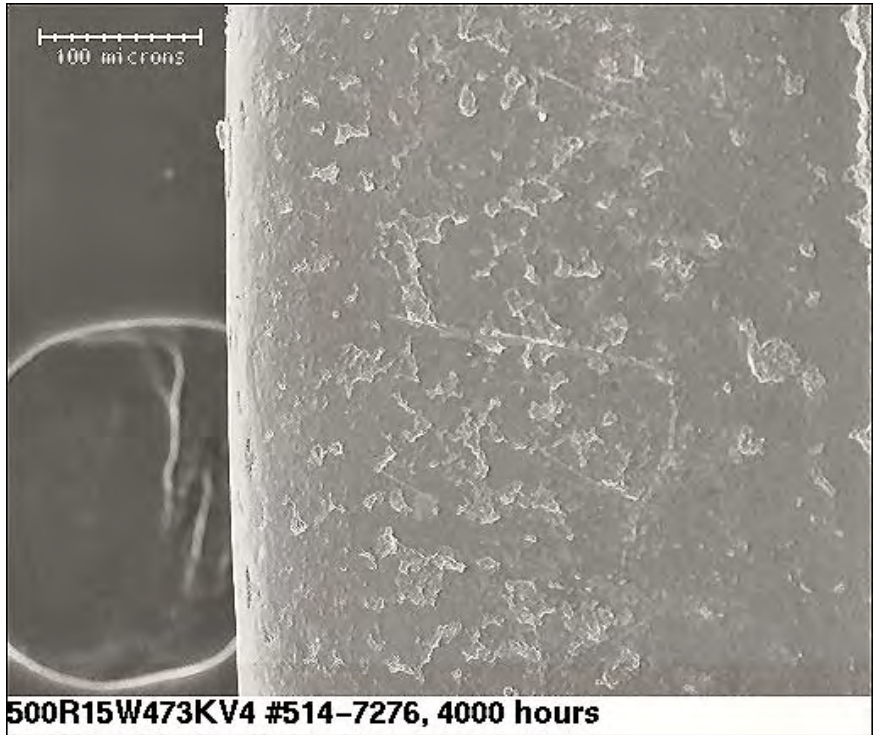
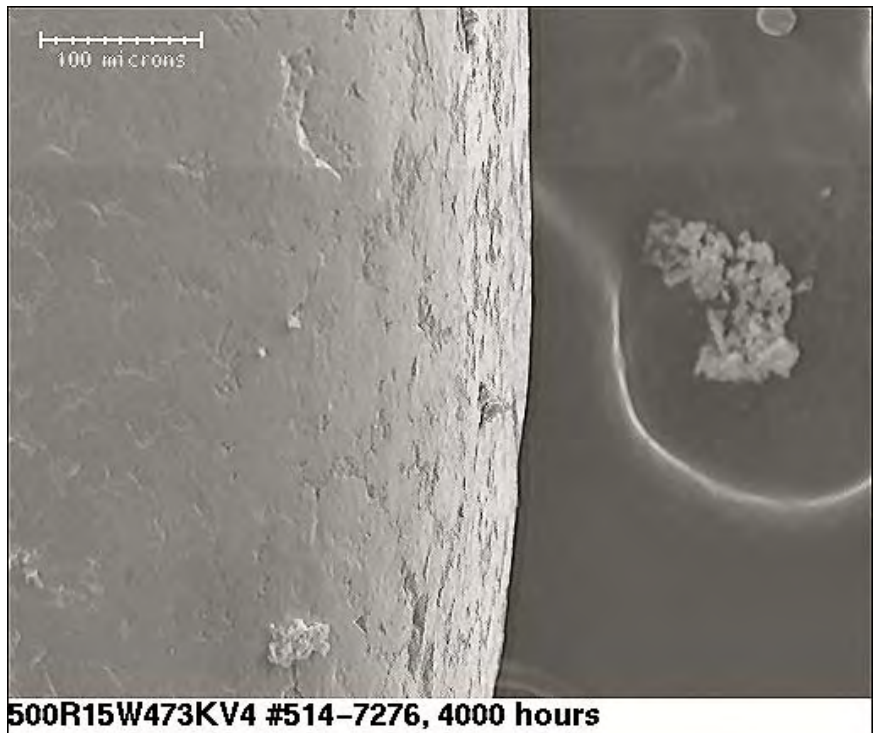


Fig. 88

250x magnification

Sample 10 - right



500R15W473KV4 – 4000 hours

Fig. 89

250x magnification

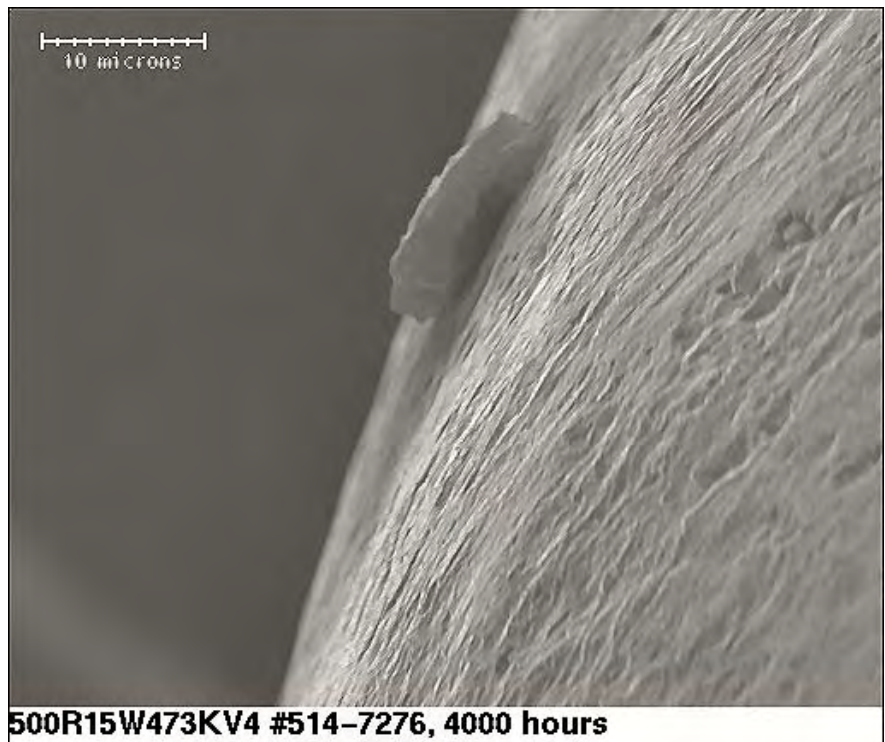
Sample 10 - left



Fig. 90

2500x magnification

Sample 10 - left



500R15W473KV4 4000 hours



Fig. 91

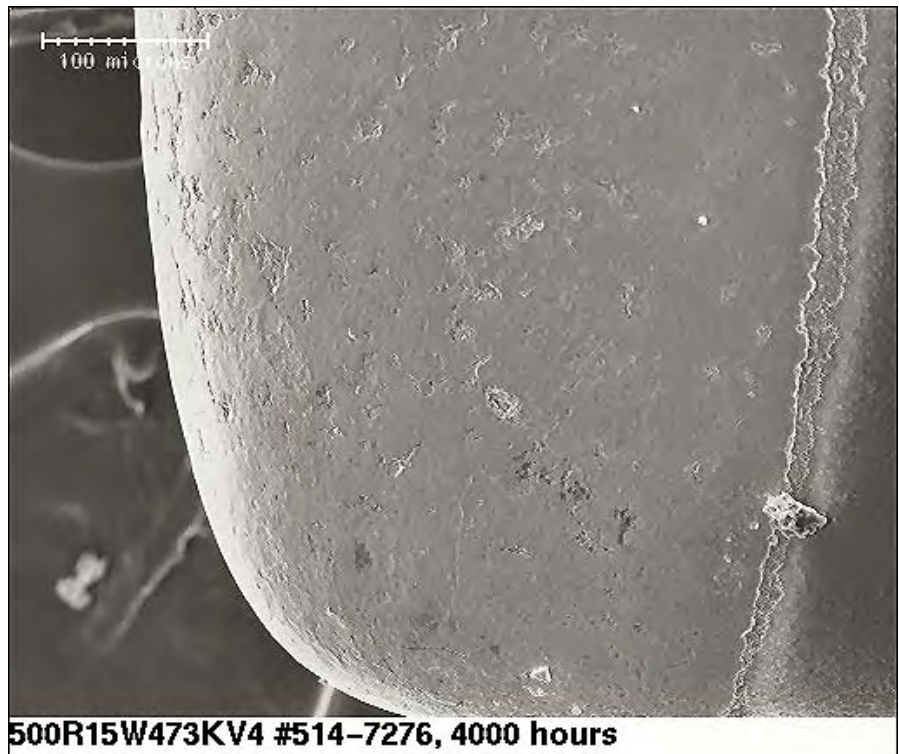
250x magnification

Sample 11 - left

Fig. 92

2500x magnification

Sample 11 - left



500R15W473KV4 – 4000 hours

Fig. 93

250x magnification

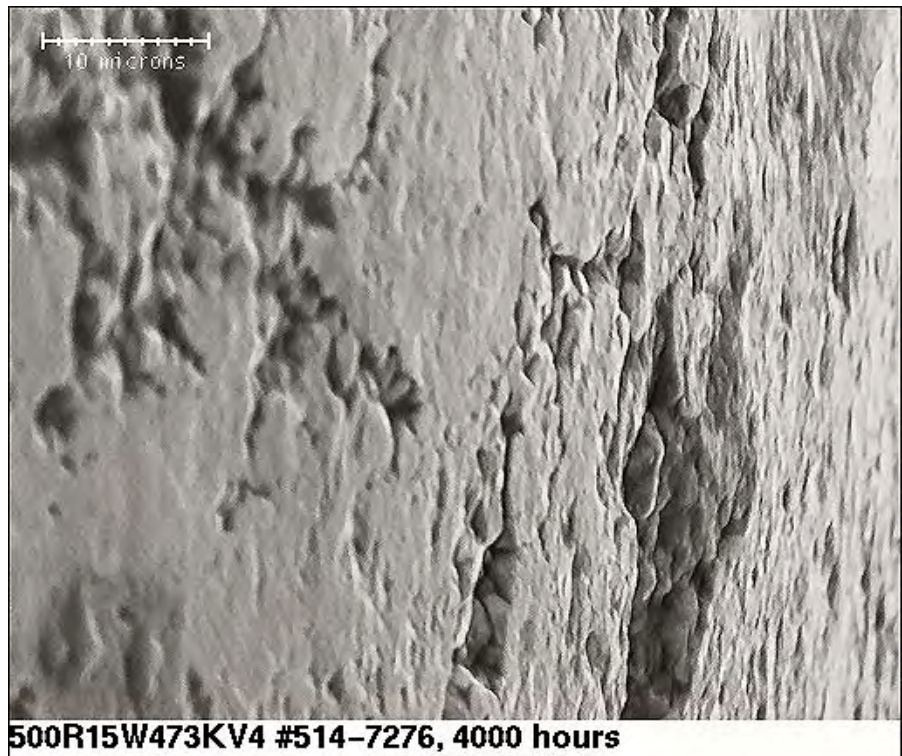
Sample 11 - right



Fig. 94

2500x magnification

Sample 11 - right



500R15W473KV4 – 4000 hours

Fig. 95

250x magnification

Sample 12 - left

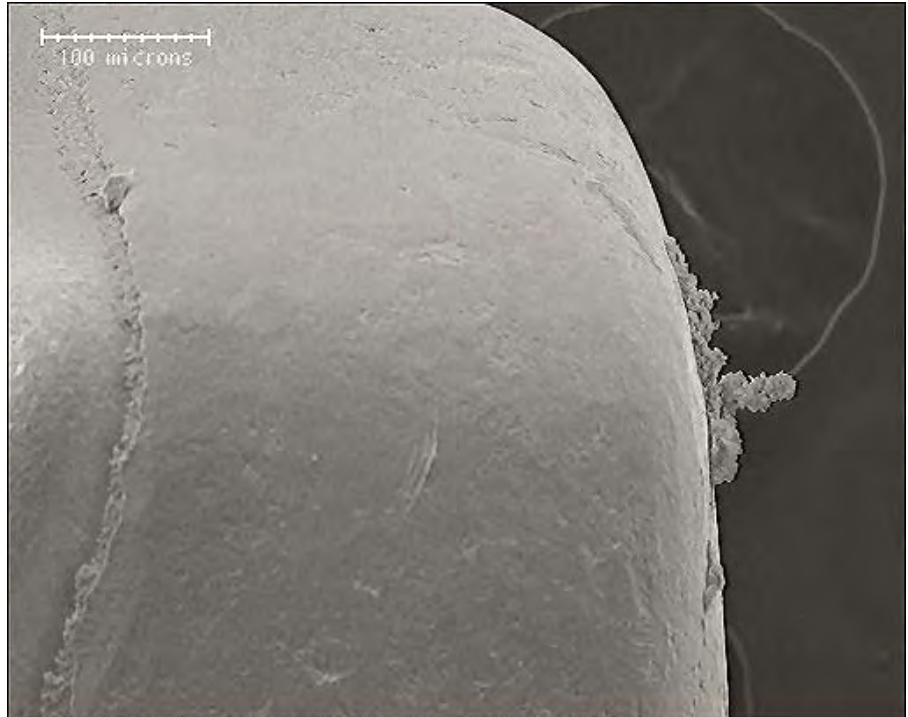


500R15W473KV4 – 4000 hours

Fig. 96

250x magnification

Sample 12 - right

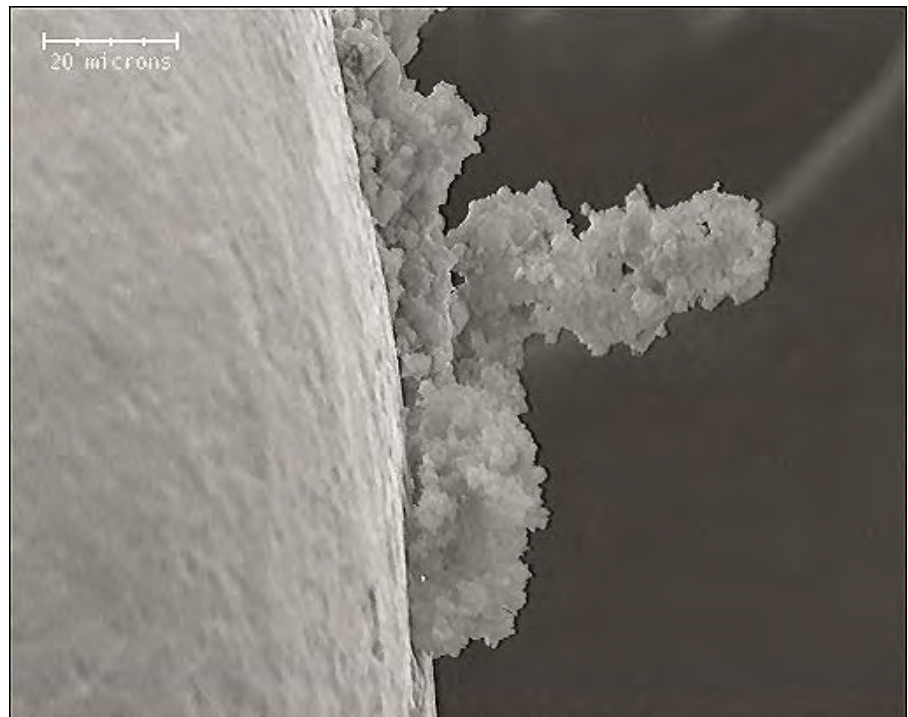


500R15W473KV4 #514-7276, 4000 hours

Fig. 97

1000x magnification

Sample 12 - right



500R15W473KV4 #514-7276, 4000 hours

500R15W473KV4 – 4000 hours

Fig. 98

250x magnification

Sample 13 - left

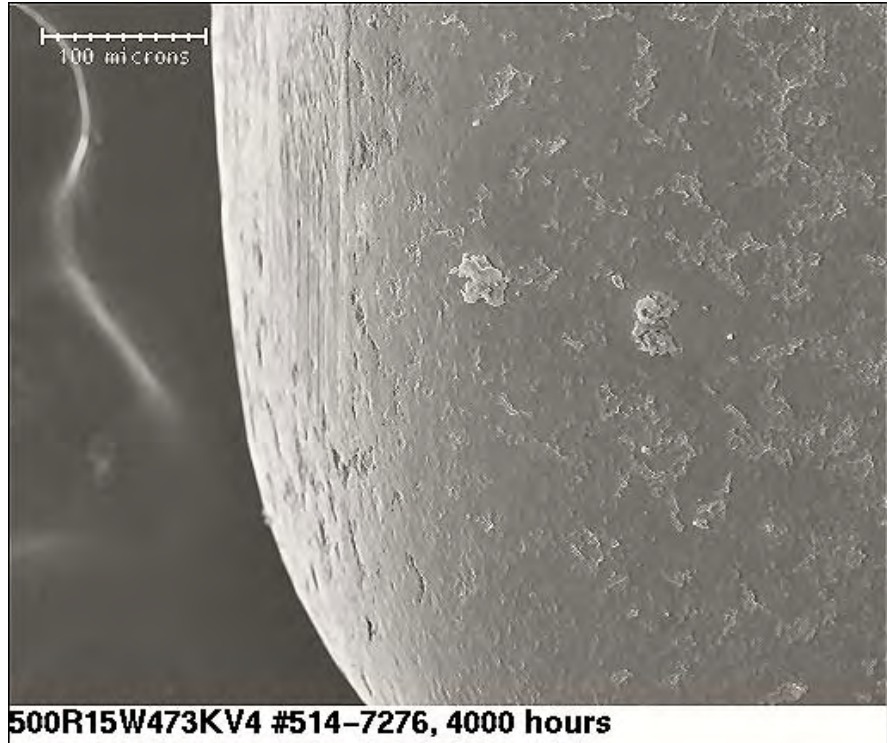
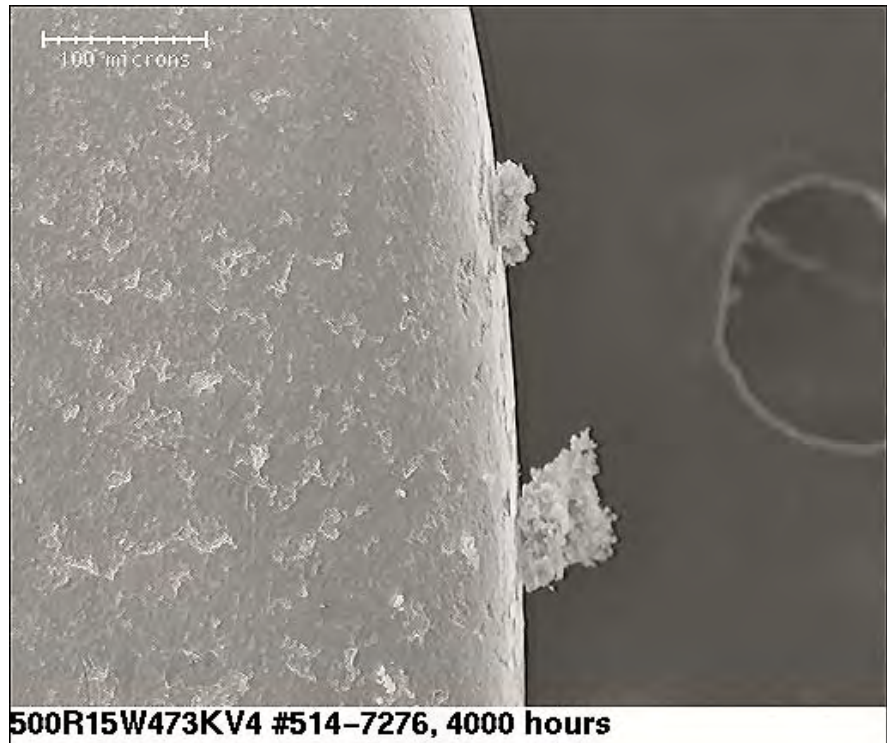


Fig. 99

250x magnification

Sample 13 - right



500R15W473KV4 – 4000 hours

Fig. 100

250x magnification

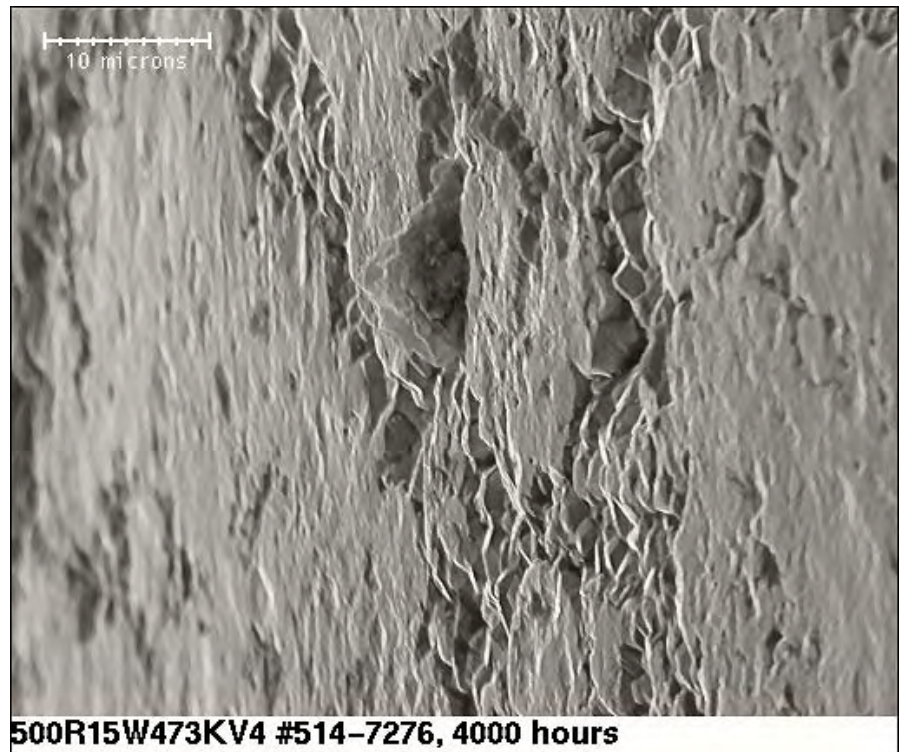
Sample 14 - right



Fig. 101

2500x magnification

Sample 14 - right

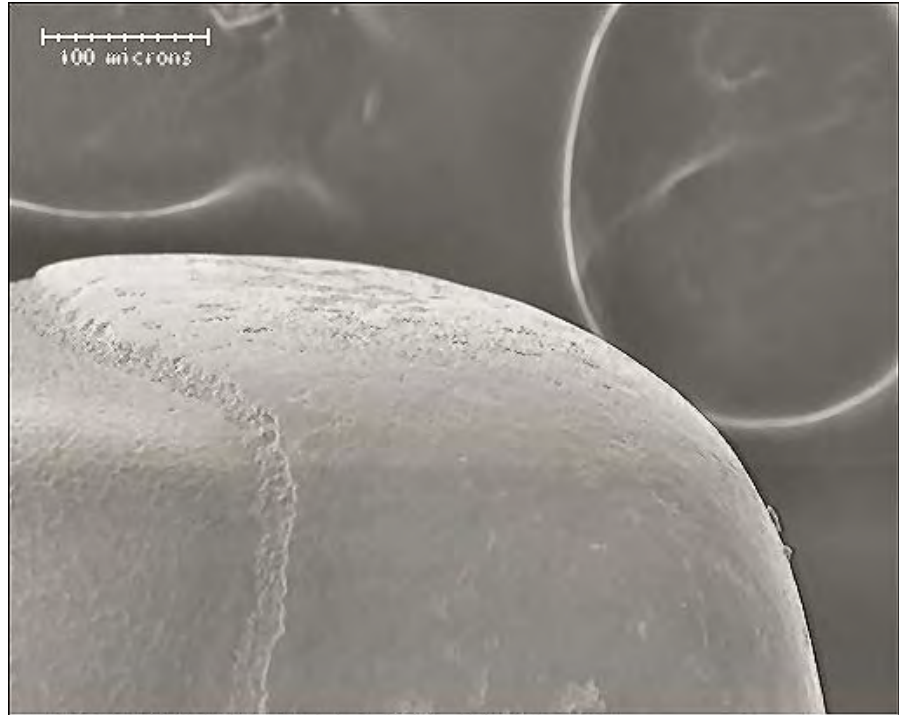


500R15W473KV4 – 4000 hours

Fig. 102

250x magnification

Sample 14 - right



500R15W473KV4 #514-7276, 4000 hours

Fig. 103

2500x magnification

Sample 14 - right



500R15W473KV4 #514-7276, 4000 hours

500R15W473KV4 – 4000 hours

Fig. 104

250x magnification

Sample 15 - left

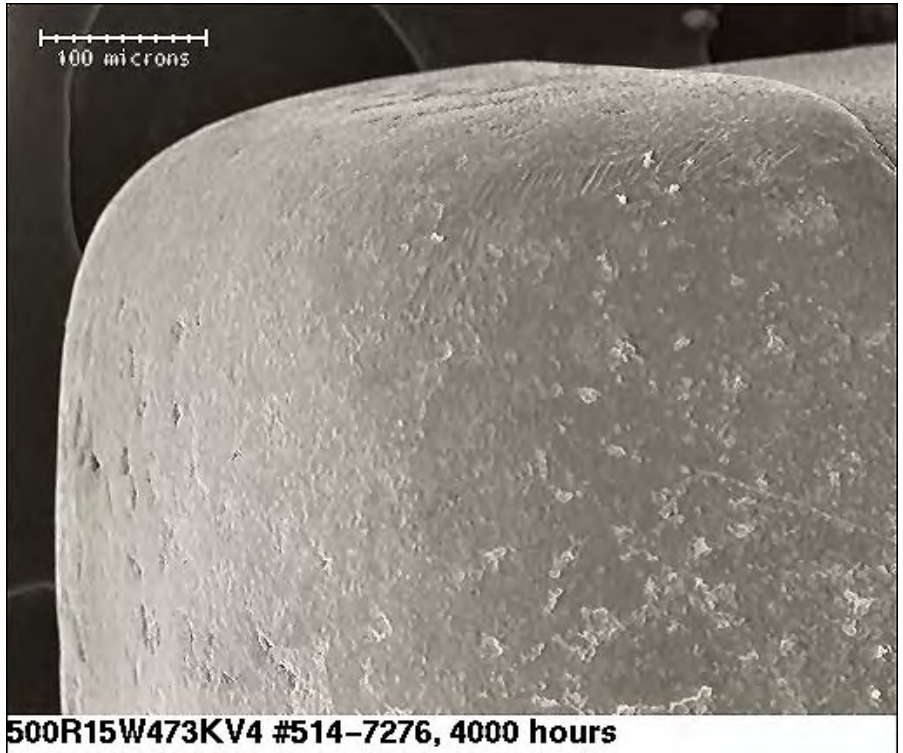


Fig. 105

250x magnification

Sample 15 - right

