



Subject: Laboratory Report # OEM138-001.2
Submitter: Omar Al Taher, Johanson Dielectrics, Inc.
Description: Tin Whisker Qualification by Temperature Cycle Stress, Part #160S41W475KV4 100% Sn
Date: November 17, 2005

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 before and after temperature cycle stress. The units were temperature cycle stressed, -55C to 85C, 1000 cycles. The devices were inspected as per JEDEC standard JESD22A121.

Four reports detailing the tin whisker results will be issued. One report for each capacitor group. The capacitor 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 cycle stress. The capacitors were labeled ‘1’ through ‘9’. The terminations on each capacitor were labeled ‘left’ and ‘right’.
- No whiskers were observed ‘pre-temperature cycle stress’ on any of the 18 terminations.
- Representative images were made for each capacitor termination before (pre) temperature cycle stress at magnifications of 250x and 2500x to show the general plating structure.
- Images were made of each capacitor termination after 1000 cycles at magnifications of 250x and 2500x to document the longest tin whisker, if present.
- The detailed tin whisker* observations are as follows:
 (* **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.)

<u>Capacitor #</u>	<u>Termination</u>	<u>Area #</u>	<u>Longest Whisker length (um)</u>	<u>Whisker Density **</u>
1	left	1	6	N/A
1	right	2	4	N/A
2	left	3	5	N/A
2	right	4	9	N/A
3	left	5	12	low
3	right	6	10	low
4	left	7	8	N/A
4	right	8	4	N/A

Capacitor #	Termination	Area #	Longest Whisker length (um)	Whisker Density
5	left	9	8	N/A
5	right	10	14	low
6	left	11	9	N/A
6	right	12	5	N/A
7	left	13	no whiskers observed	N/A
7	right	14	4	N/A
8	left	15	no whiskers observed	N/A
8	right	16	5	N/A
9	left	17	6	N/A
9	right	18	10	low

** Note: N/A indicates ‘not applicable’ when no whiskers >10um were observed. Whisker Density is based on observed whiskers 10um or more in length. Terminations with a ‘low’ reported whisker density may in fact have a ‘high’ density of growths (pre-whiskers <10um in length). If additional stress is applied, these growths (pre-whiskers) may lengthen beyond 10um.

- Observed whiskers were of the ‘straight’ or ‘bent’ classification.
- All observed whiskers pass the criteria requiring a length of less than 40um as per iNEMI test requirements. (JEDEC does not stipulate a fail criteria, only a test procedure.)

Conclusion:

All devices examined within the capacitor group, **160S41W475KV4 lot #514-5389 100% Sn** and subjected to temperature cycling stress as certified by Silicon Cert Ltd. meet the acceptance requirements for Class 2 devices as stipulated by iNEMI ‘Tin Whisker Acceptance Test Requirements’, July 28, 2004, paragraph 18.2.3.

160S41W475KV4 – pre Temp Cycle

Fig. 1

250x magnification

Sample 1 - left



Fig. 2

2500x magnification

Sample 1 - left



160S41W475KV4 - 1000 cycles

Fig. 3

250x magnification

Sample 1 - left

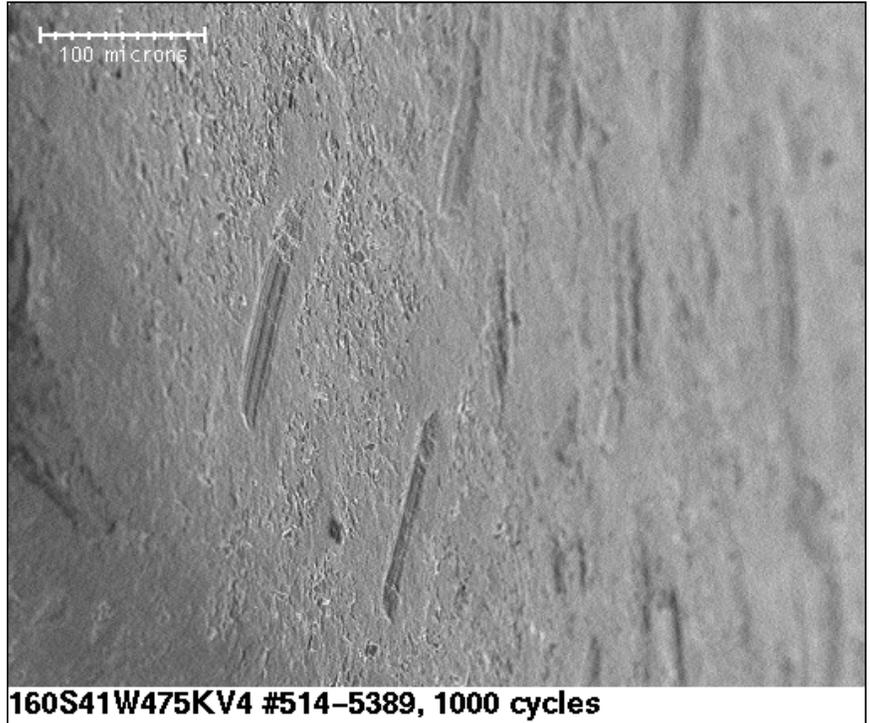
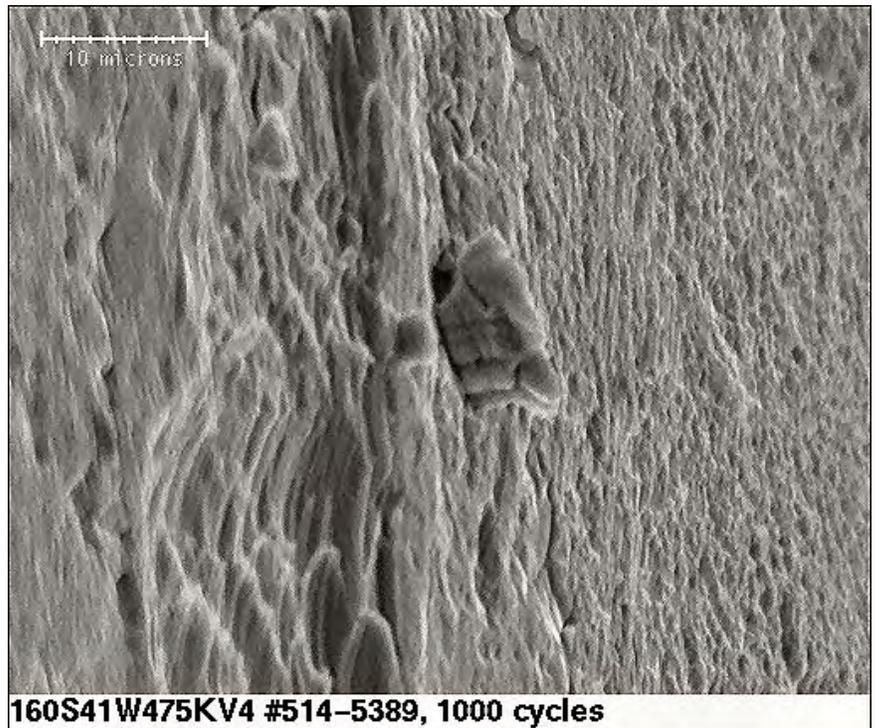


Fig. 4

2500x magnification

Sample 1 - left



160S41W475KV4 – pre Temp Cycle

Fig. 5

250x magnification

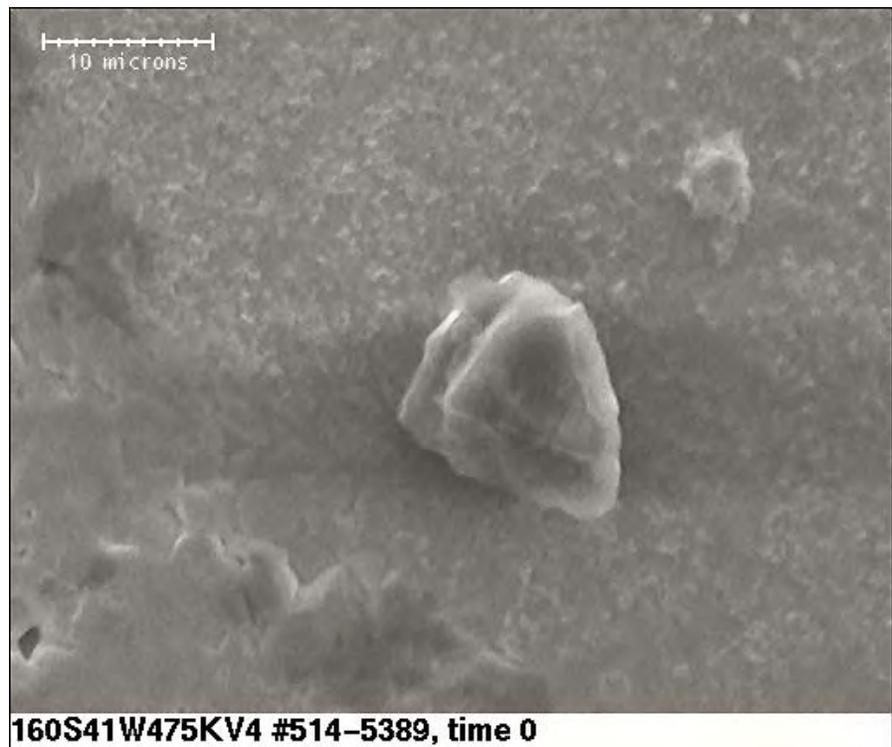
Sample 1 - right



Fig. 6

2500x magnification

Sample 1 - right



160S41W475KV4 - 1000 cycles

Fig. 7

250x magnification

Sample 1 - right

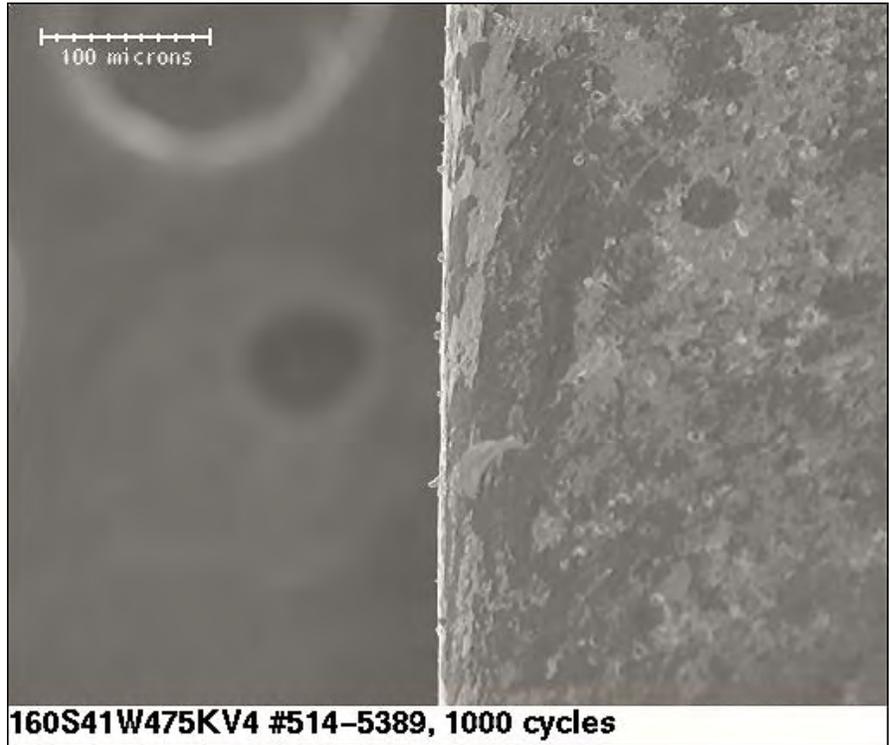
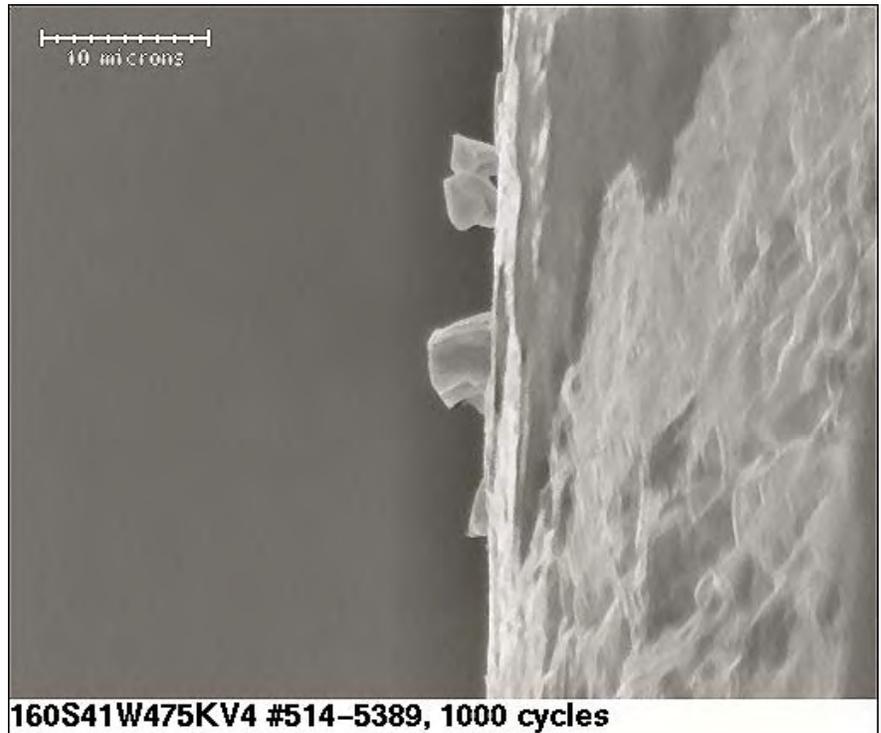


Fig. 8

2500x magnification

Sample 1 - right



160S41W475KV4 – pre Temp Cycle

Fig. 9

250x magnification

Sample 2 - left



Fig. 10

2500x magnification

Sample 2 - left



160S41W475KV4 - 1000 cycles

Fig. 11

250x magnification

Sample 2 - left



Fig. 12

2500x magnification

Sample 2 - left



160S41W475KV4 – pre Temp Cycle

Fig. 13

250x magnification

Sample 2 - right

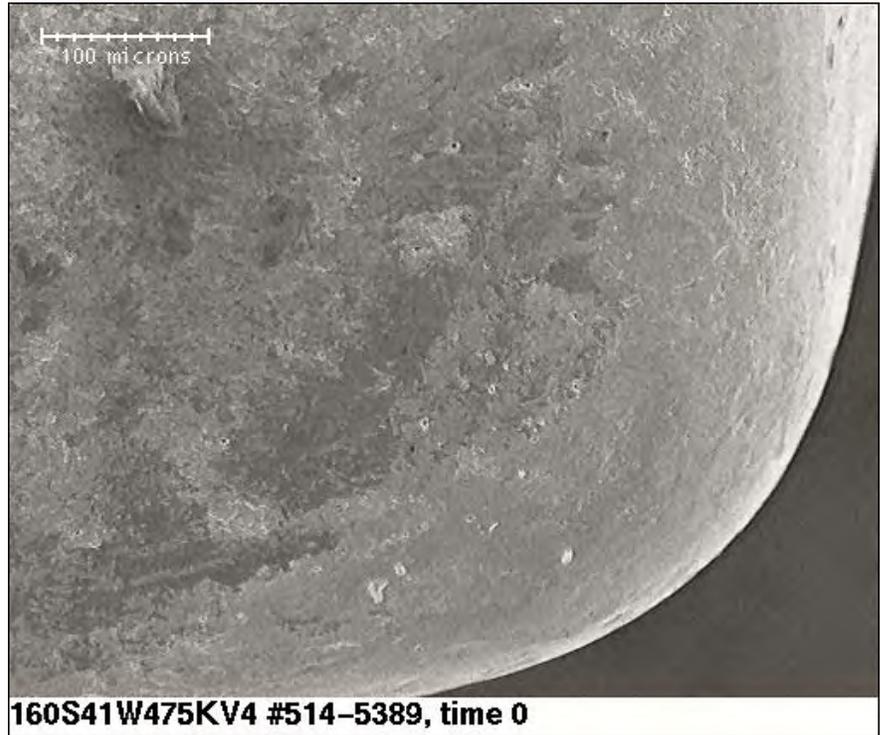
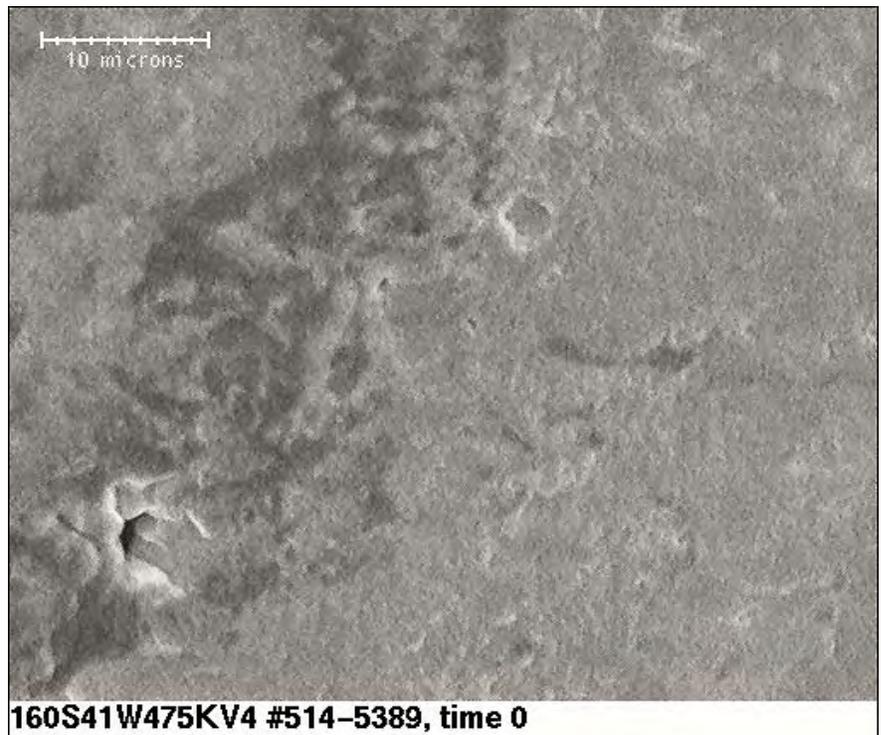


Fig. 14

2500x magnification

Sample 2 - right



160S41W475KV4 - 1000 cycles

Fig. 15

250x magnification

Sample 2 - right

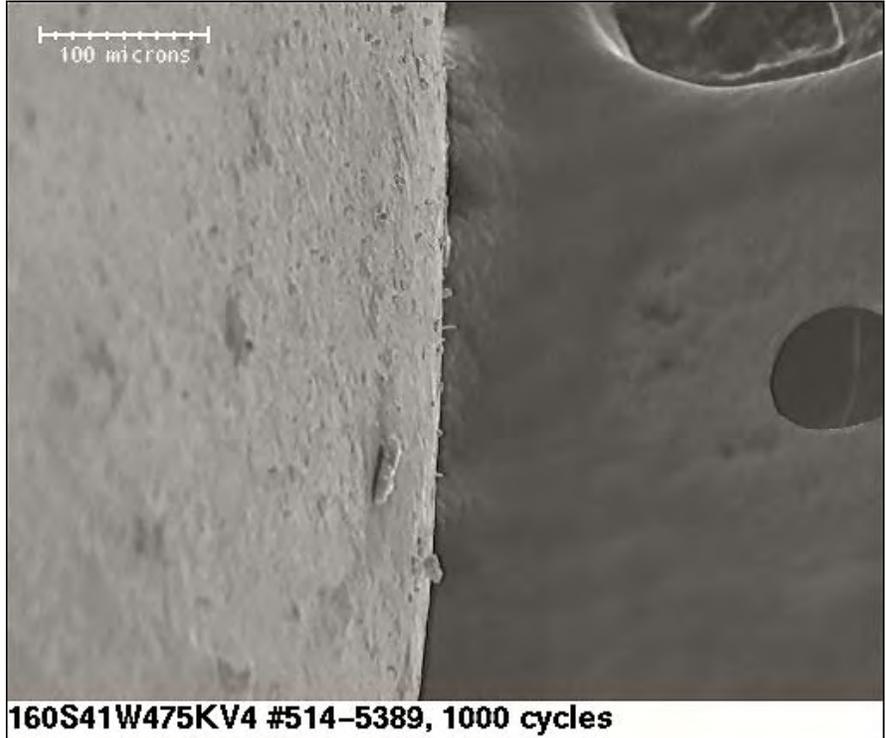
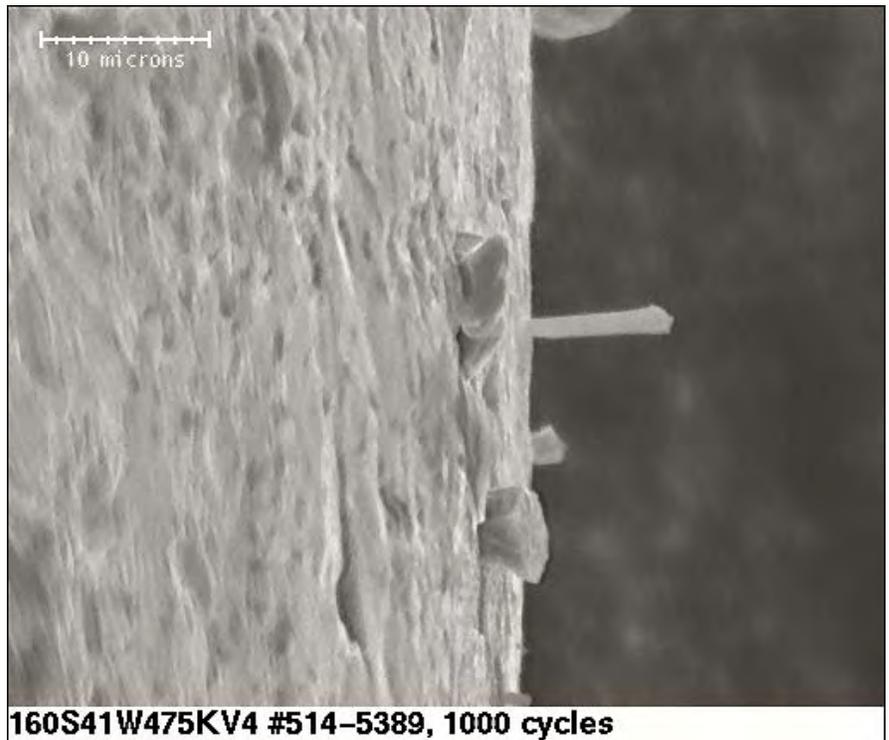


Fig. 16

2500x magnification

Sample 2 - right



160S41W475KV4 – pre Temp Cycle

Fig. 17

250x magnification

Sample 3 - left

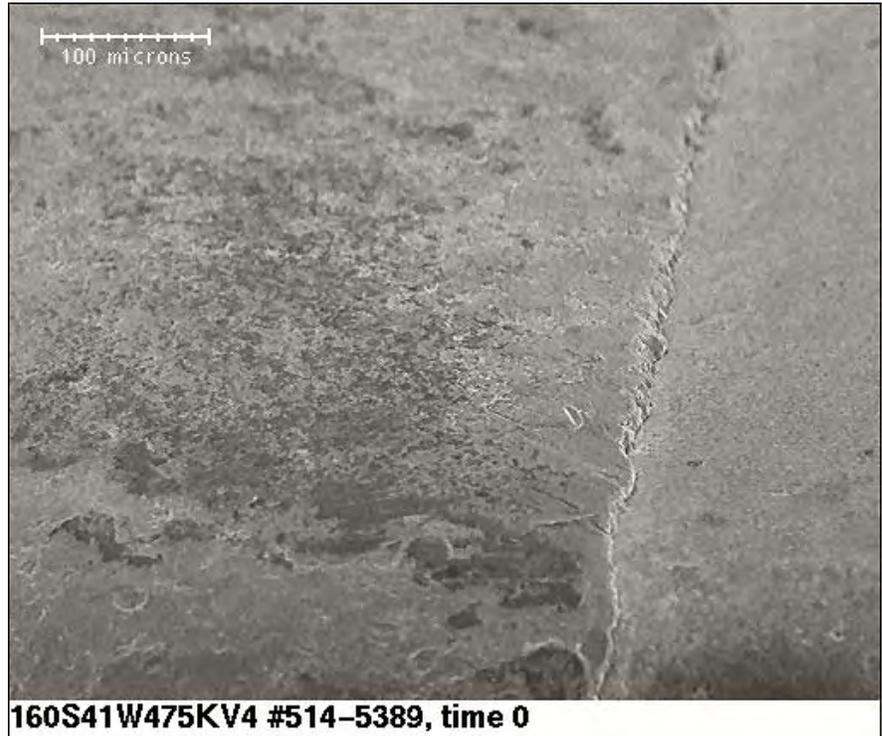


Fig. 18

2500x magnification

Sample 3 - left



160S41W475KV4 - 1000 cycles

Fig. 19

250x magnification

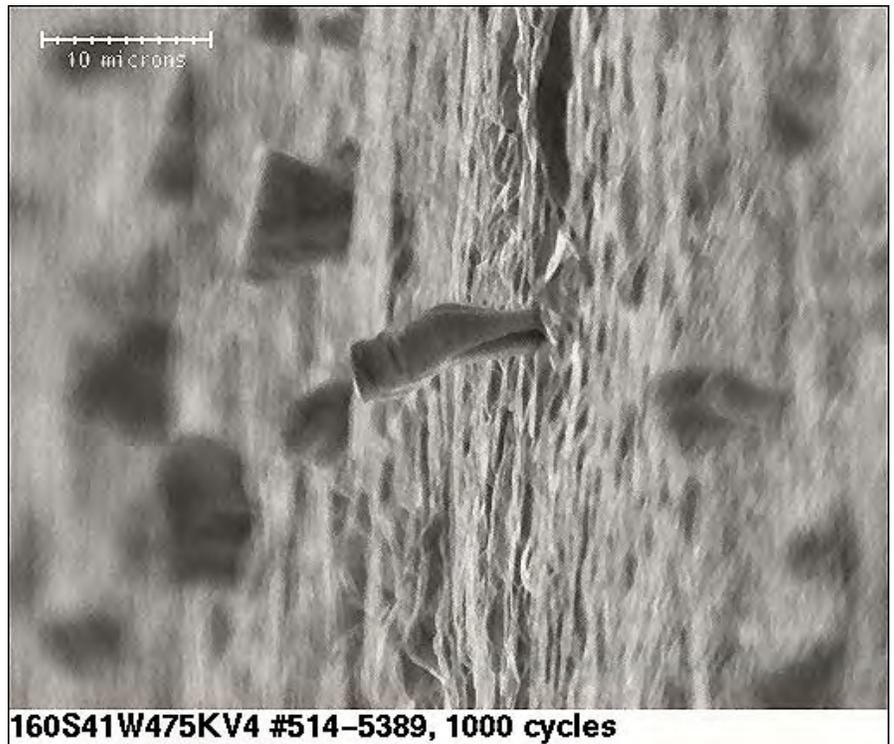
Sample 3 - left



Fig. 20

2500x magnification

Sample 3 - left



160S41W475KV4 – pre Temp Cycle

Fig. 21

250x magnification

Sample 3 - right



Fig. 22

2500x magnification

Sample 3 - right



160S41W475KV4 - 1000 cycles

Fig. 23

250x magnification

Sample 3 - right

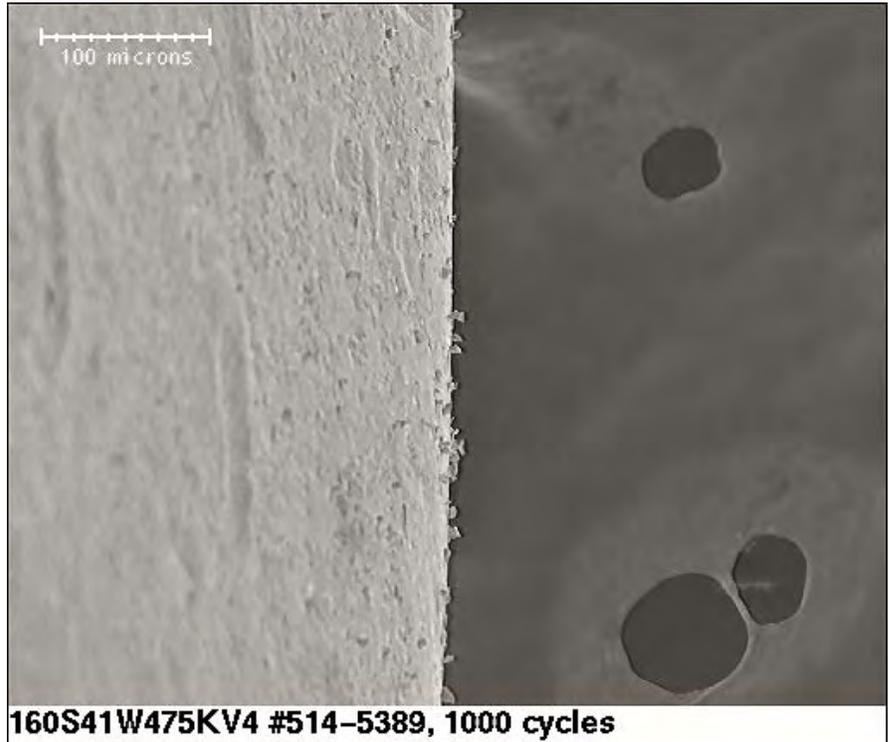
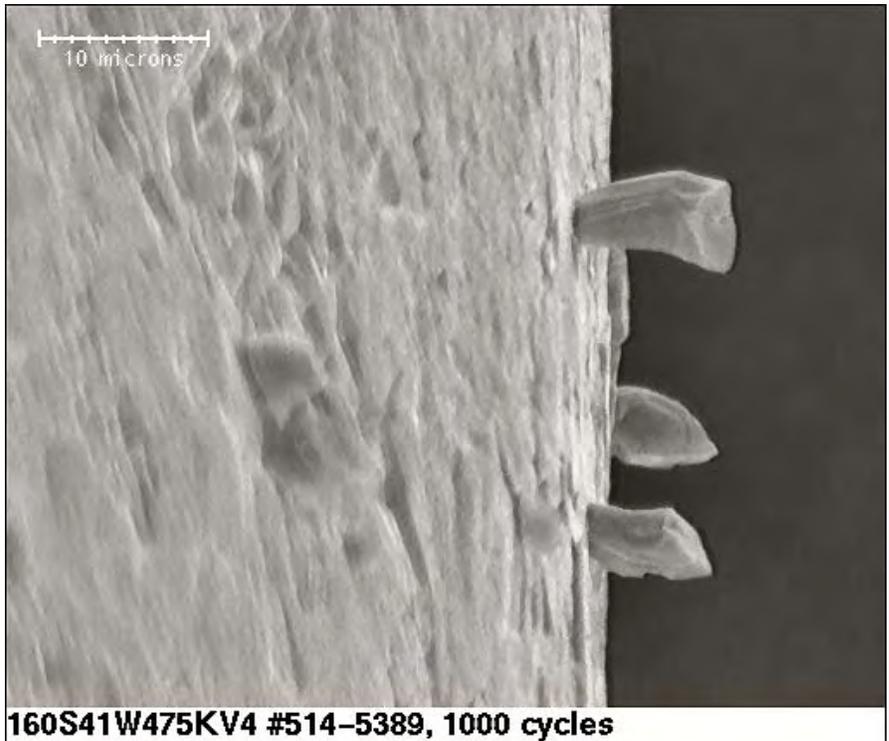


Fig. 24

2500x magnification

Sample 3 - right



160S41W475KV4 – pre Temp Cycle

Fig. 25

250x magnification

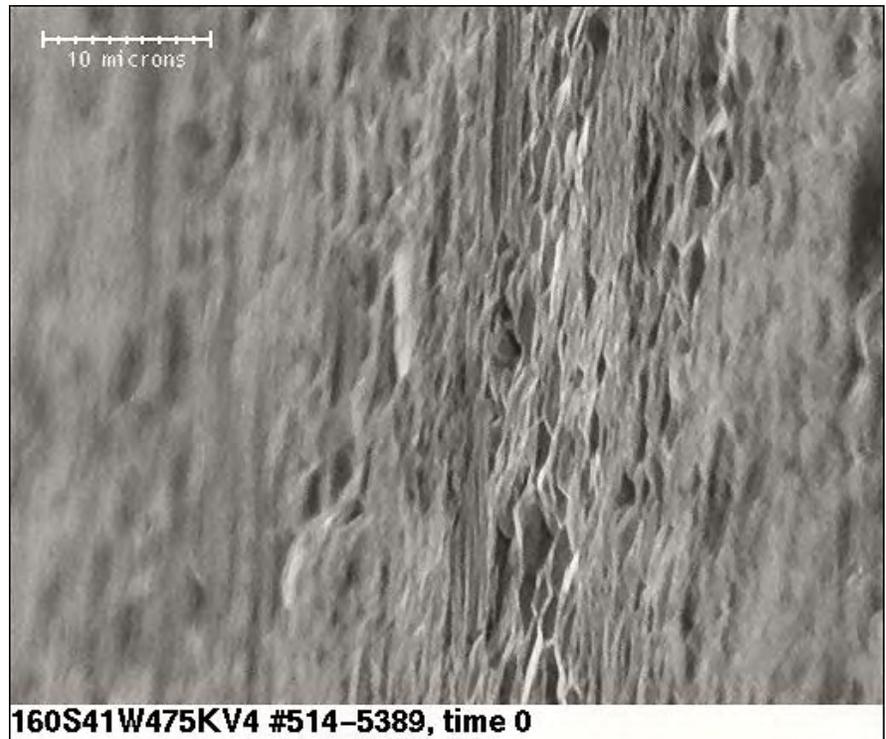
Sample 4 - left



Fig. 26

2500x magnification

Sample 4 - left



160S41W475KV4 - 1000 cycles

Fig. 27

250x magnification

Sample 4 - left

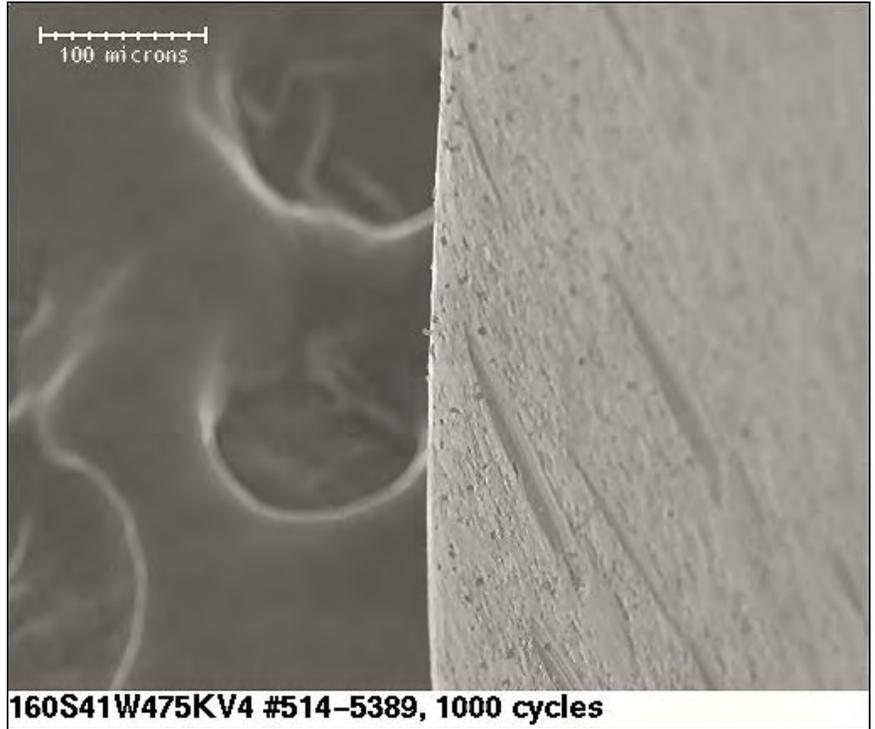


Fig. 28

2500x magnification

Sample 4 - left



160S41W475KV4 – pre Temp Cycle

Fig. 29

250x magnification

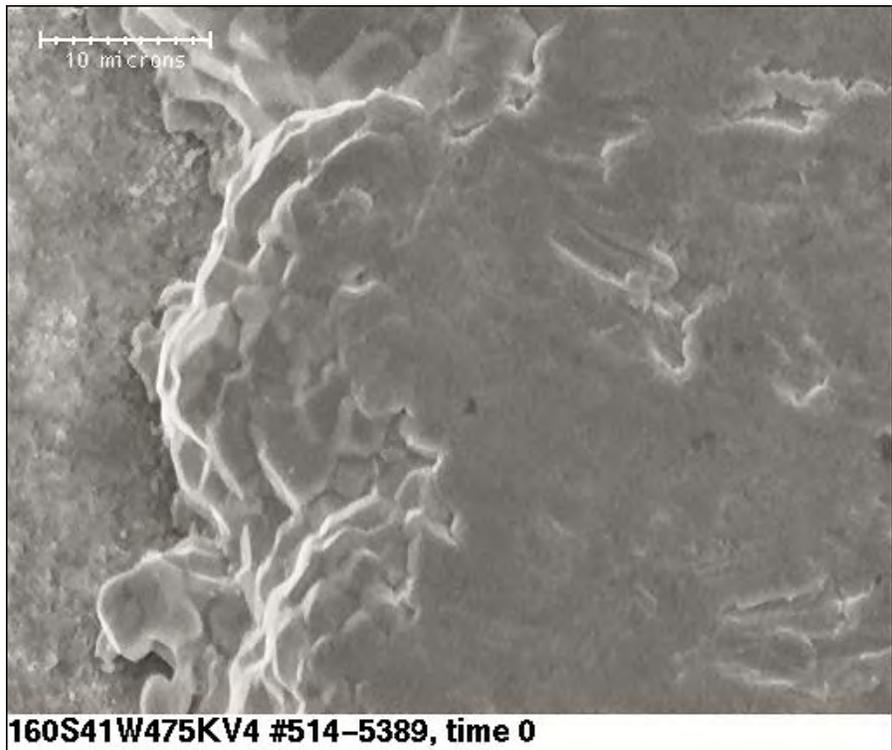
Sample 4 - right



Fig. 30

2500x magnification

Sample 4 - right



160S41W475KV4 - 1000 cycles

Fig. 31

250x magnification

Sample 4 - right



Fig. 32

2500x magnification

Sample 4 - right



160S41W475KV4 – pre Temp Cycle

Fig. 33

250x magnification

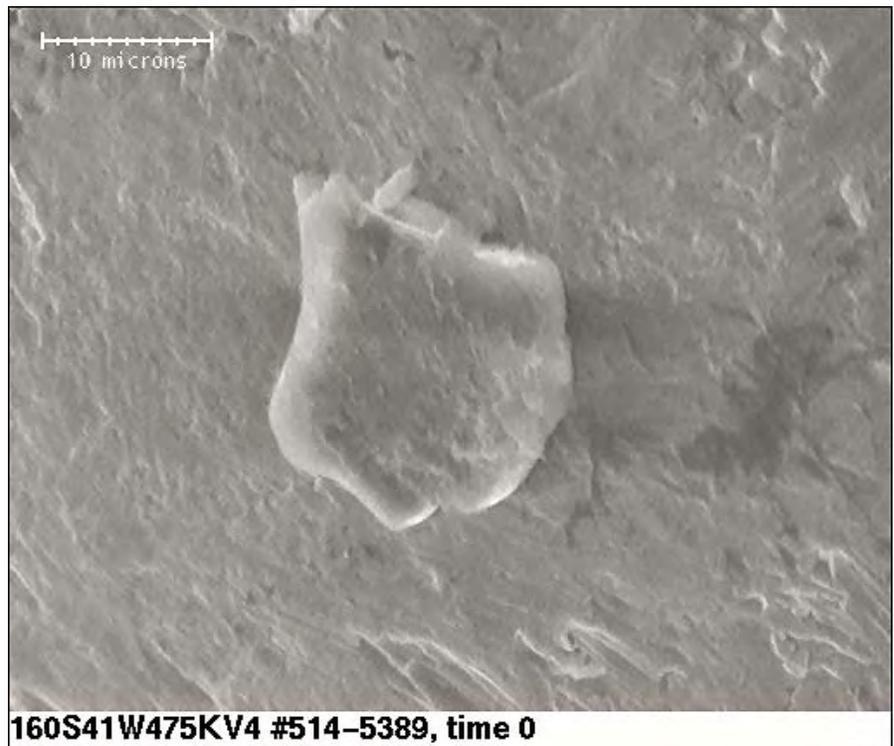
Sample 5 - left



Fig. 34

2500x magnification

Sample 5 - left



160S41W475KV4 - 1000 cycles

Fig. 35

250x magnification

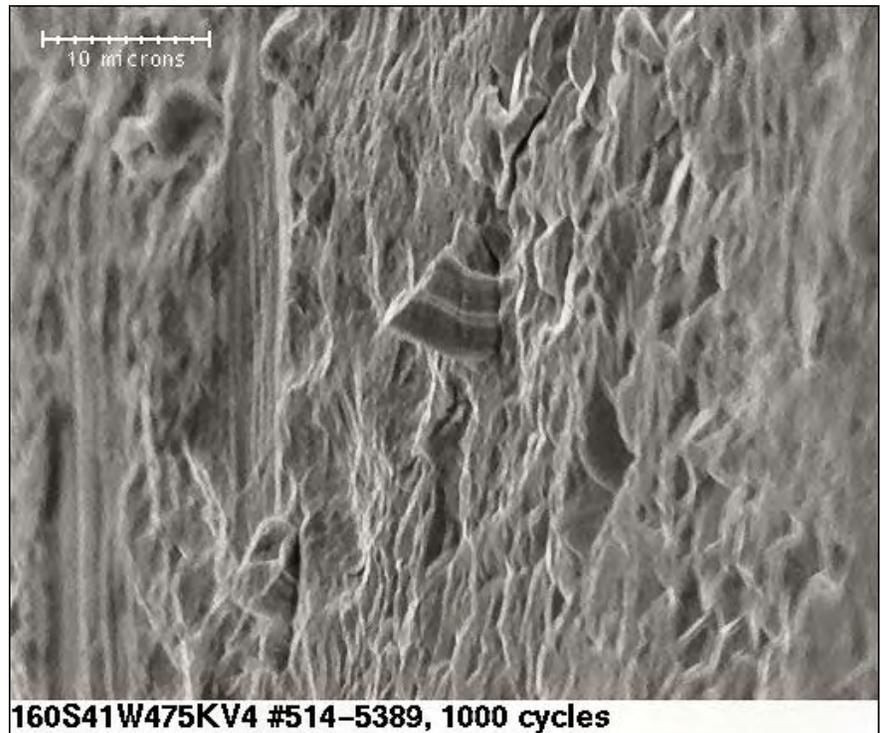
Sample 5 - left



Fig. 36

2500x magnification

Sample 5 - left



160S41W475KV4 – pre Temp Cycle

Fig. 37

250x magnification

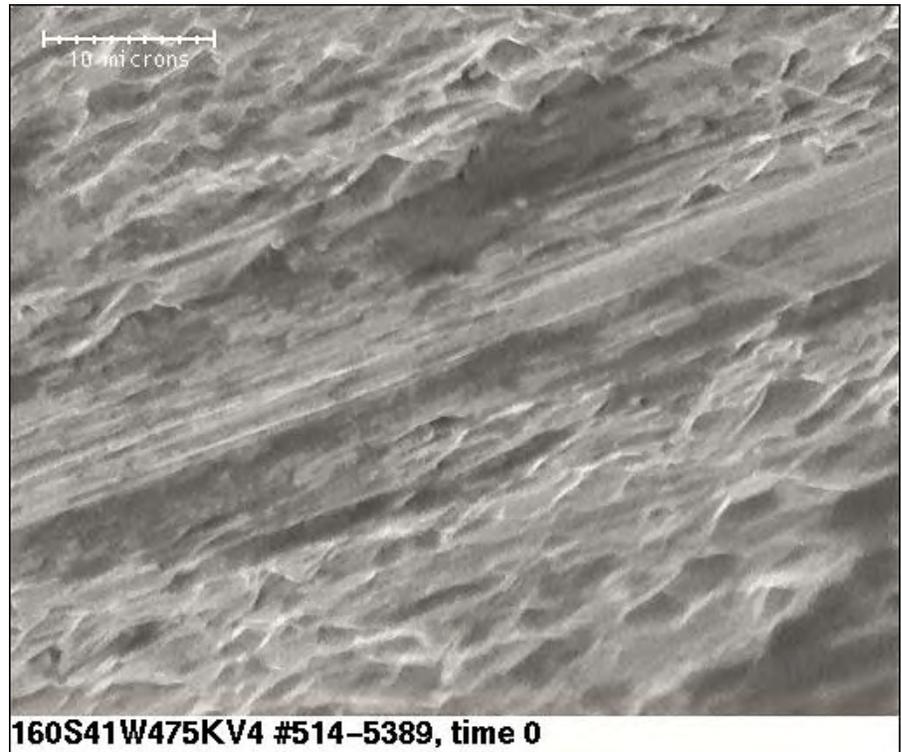
Sample 5 - right



Fig. 38

2500x magnification

Sample 5 - right



160S41W475KV4 - 1000 cycles

Fig. 39

250x magnification

Sample 5 - right

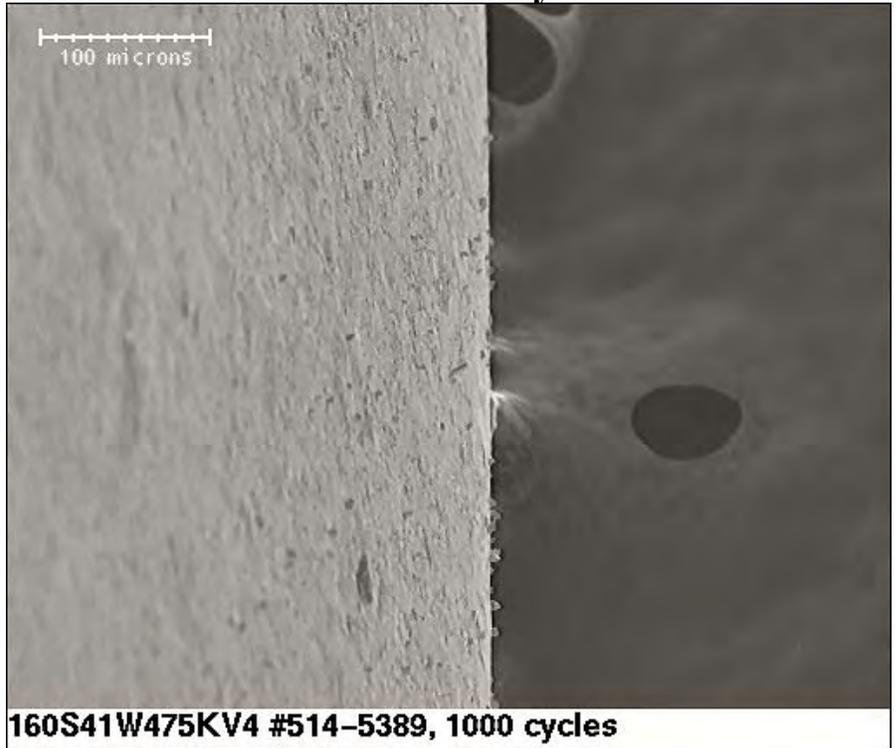
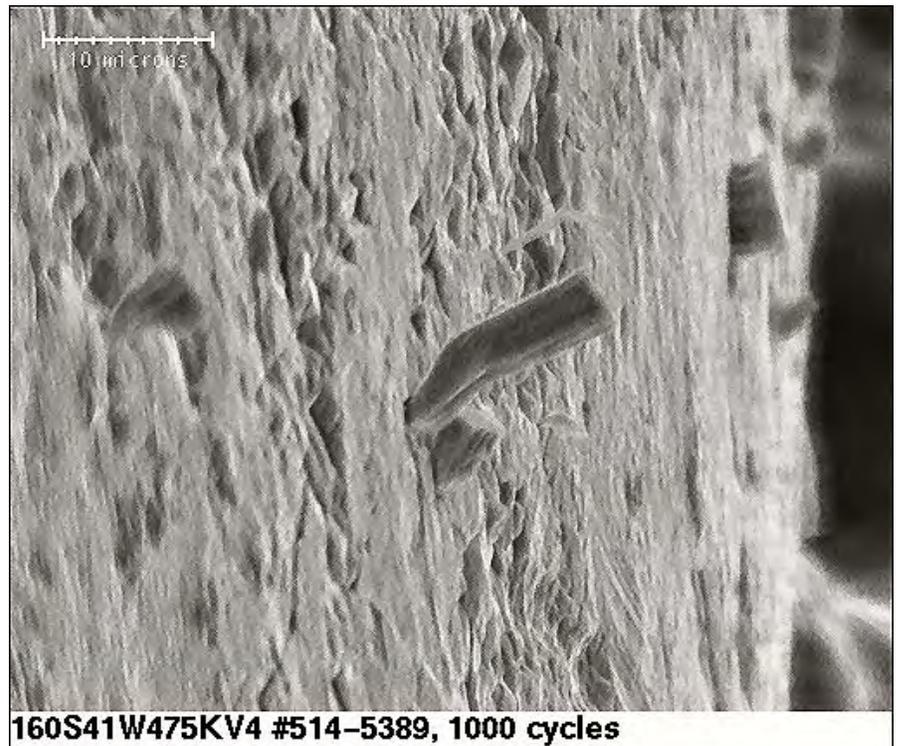


Fig. 40

2500x magnification

Sample 5 - right



160S41W475KV4 – pre Temp Cycle

Fig. 41

250x magnification

Sample 6 - left

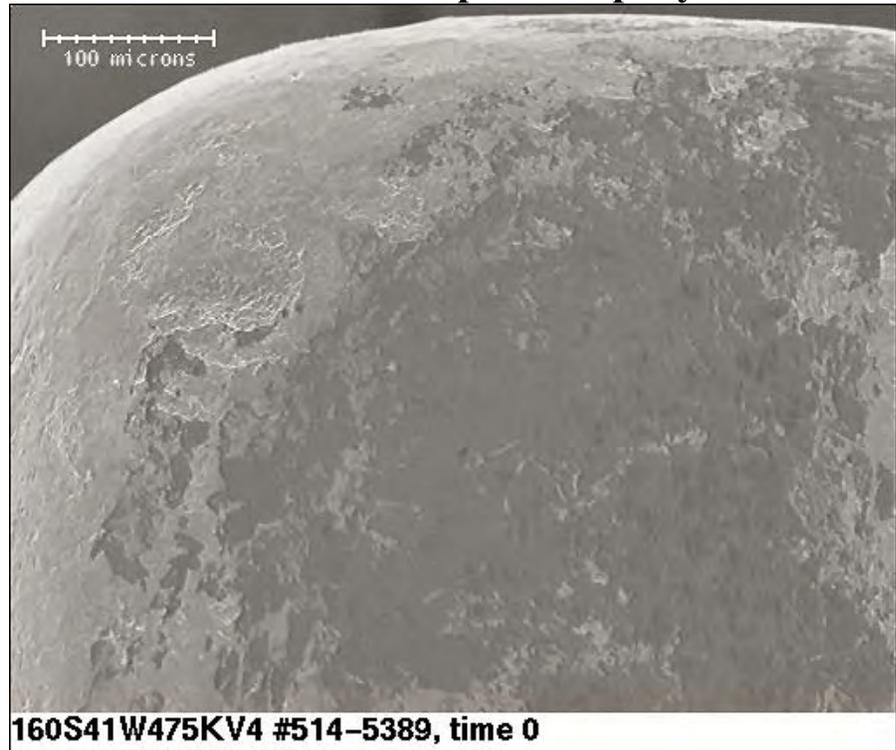


Fig. 42

2500x magnification

Sample 6 - left



16S41W475KV4 - 1000 cycles

Fig. 43

250x magnification

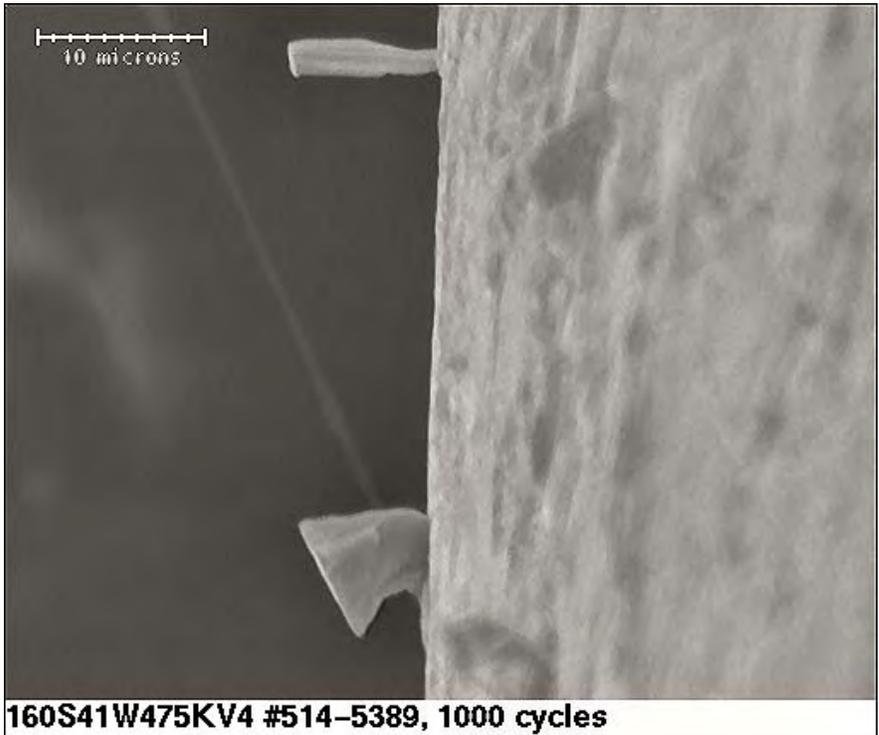
Sample 6 - left



Fig. 44

2500x magnification

Sample 6 - left



160S41W475KV4 – pre Temp Cycle

Fig. 45

250x magnification

Sample 6 - right

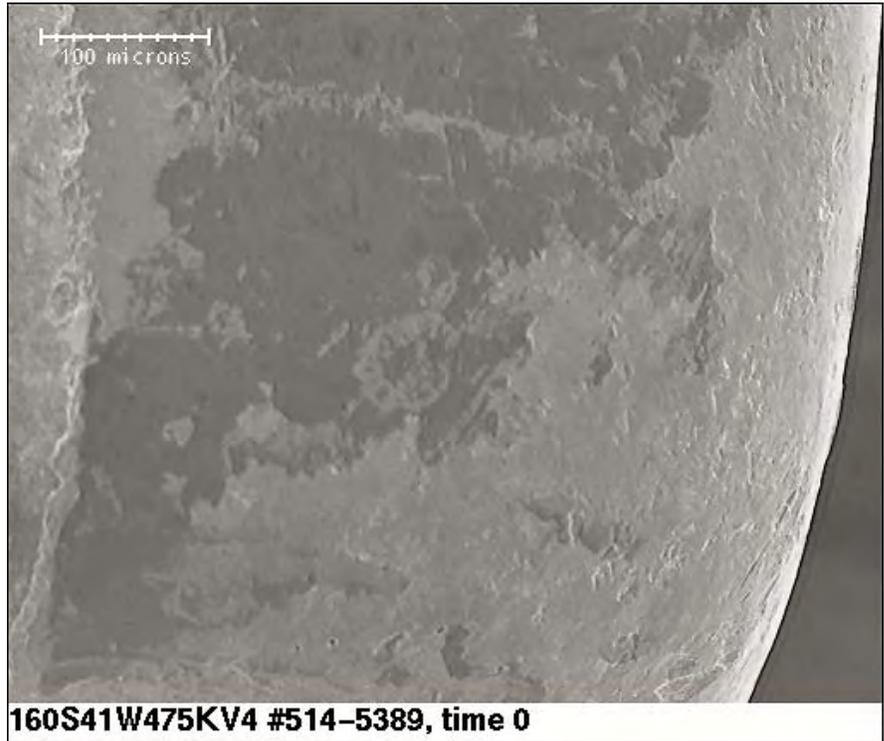
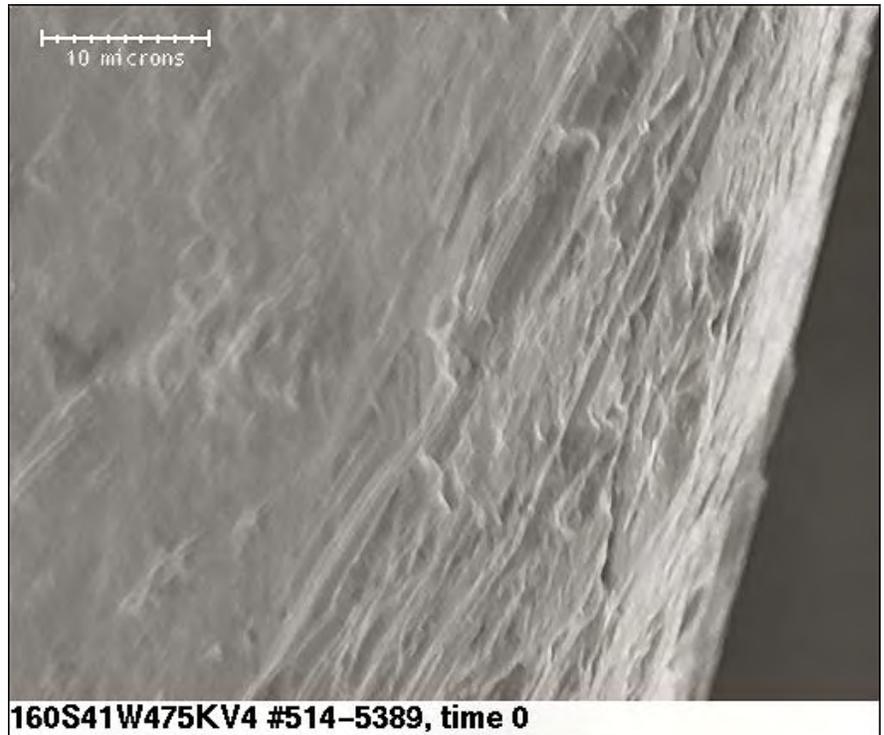


Fig. 46

2500x magnification

Sample 6 - right



160S41W475KV4 - 1000 cycles

Fig. 47

250x magnification

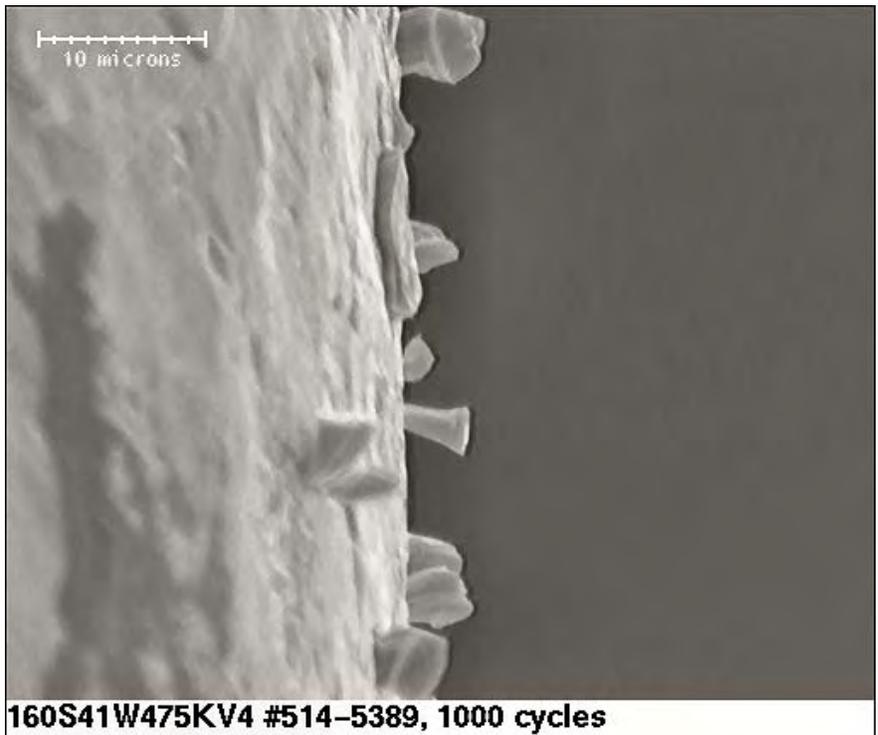
Sample 6 - right



Fig. 48

2500x magnification

Sample 6 - right



160S41W475KV4 – pre Temp Cycle

Fig. 49

250x magnification

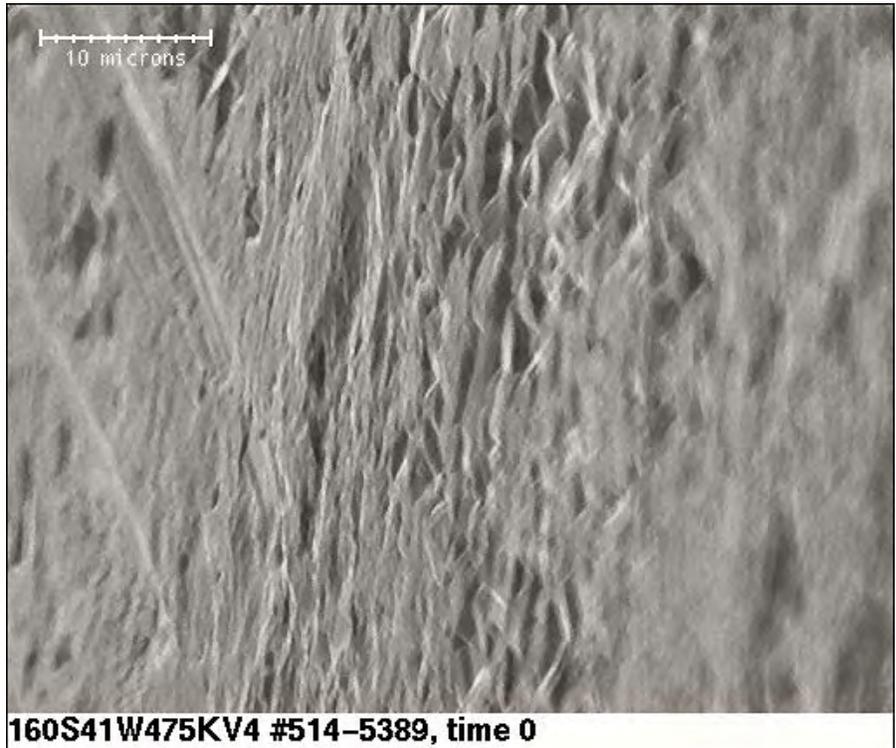
Sample 7 - left



Fig. 50

2500x magnification

Sample 7 - left



160S41W475KV4 - 1000 cycles

Fig. 51

250x magnification

Sample 7 - left

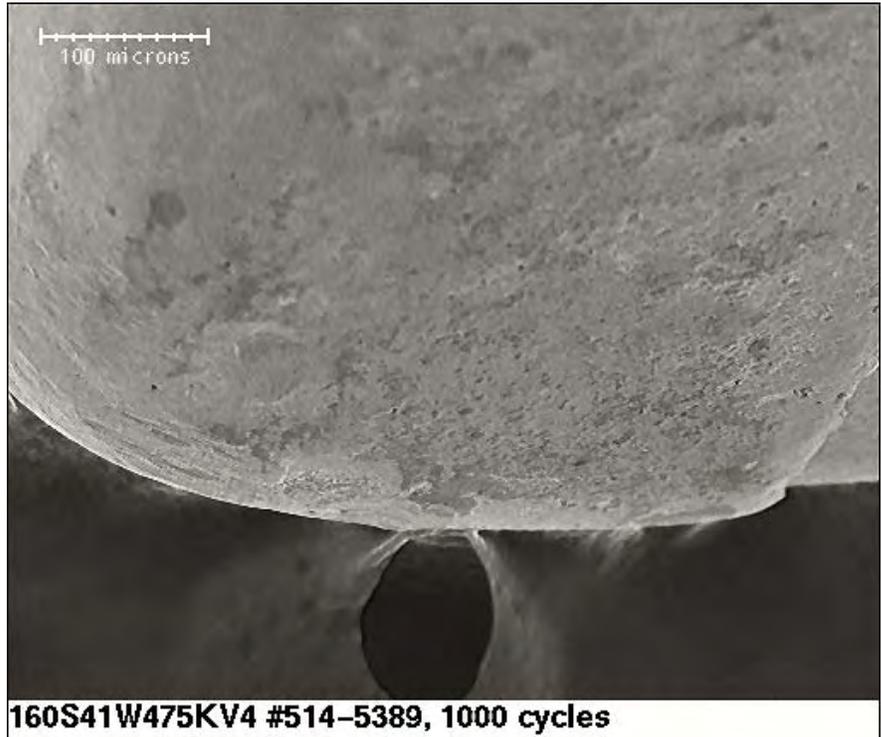
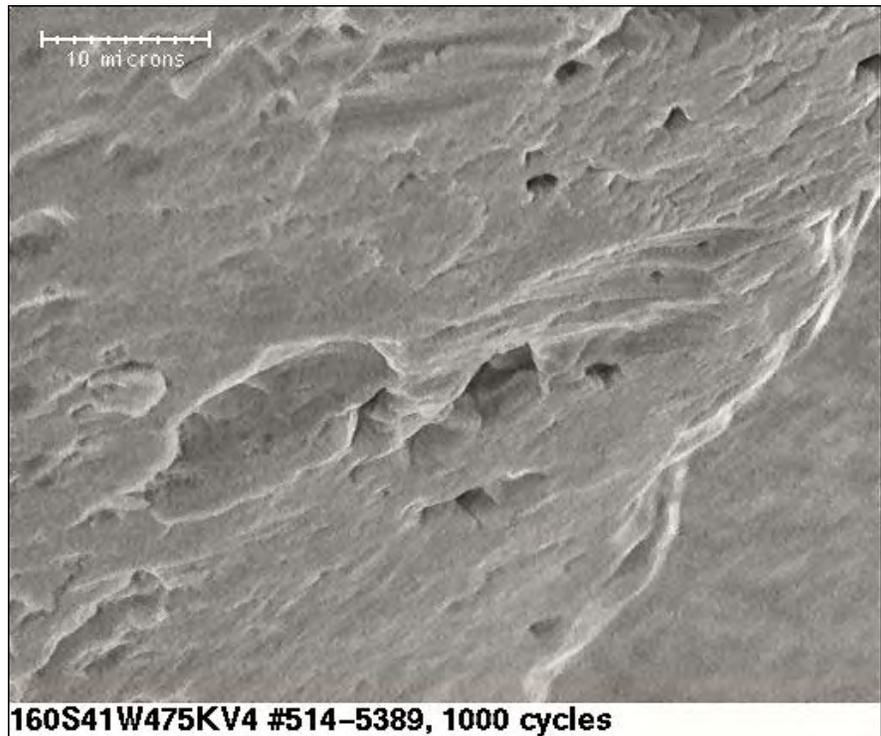


Fig. 52

2500x magnification

Sample 7 - left



160S41W475KV4 – pre Temp Cycle

Fig. 53

250x magnification

Sample 7 - right

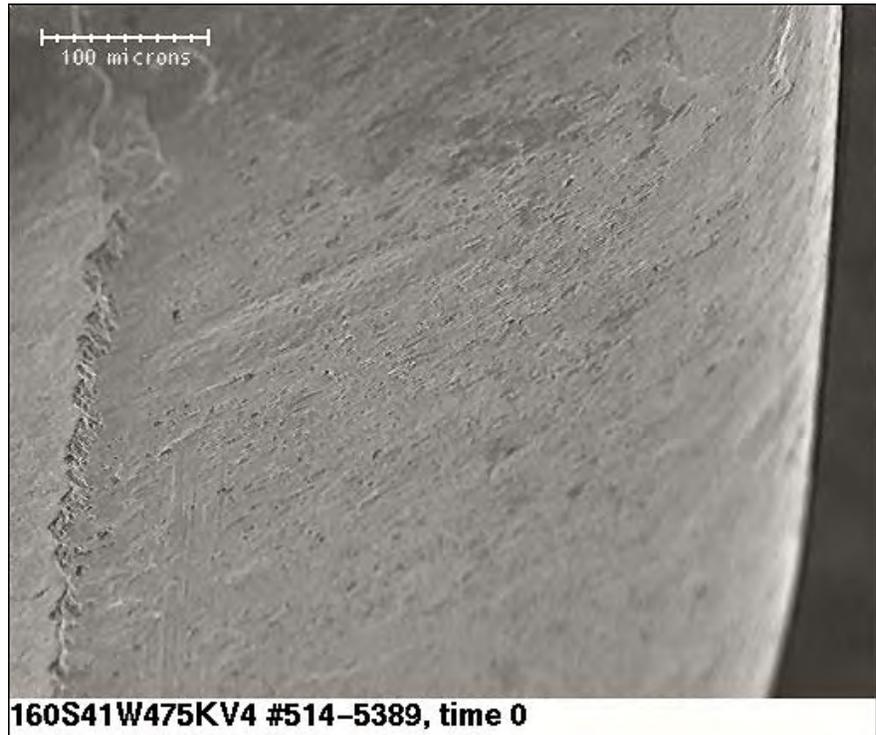
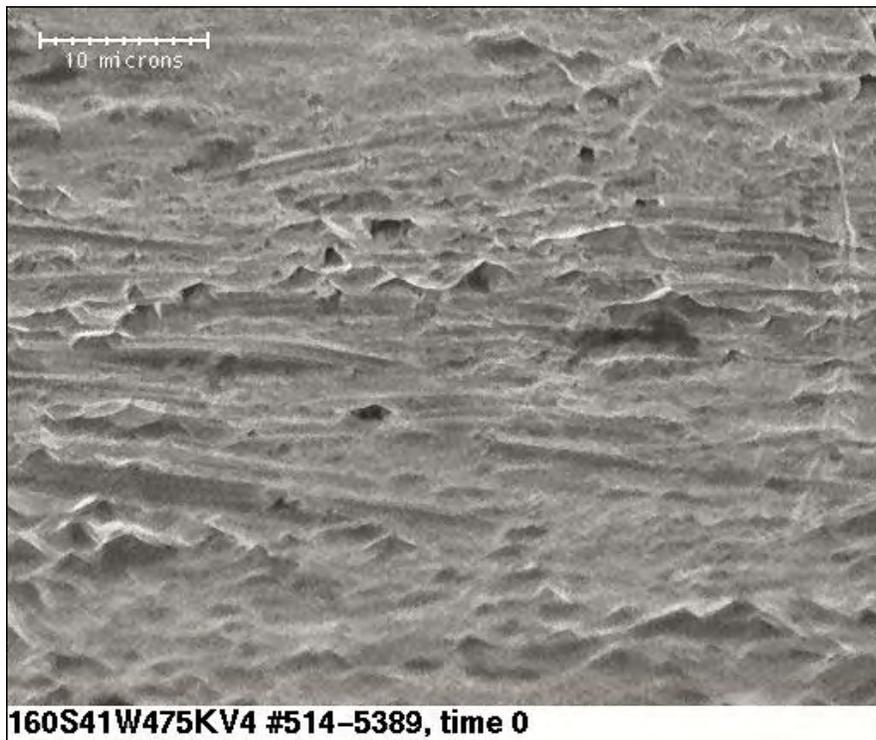


Fig. 54

2500x magnification

Sample 7 - right



160S41W475KV4 - 1000 cycles

Fig. 55

250x magnification

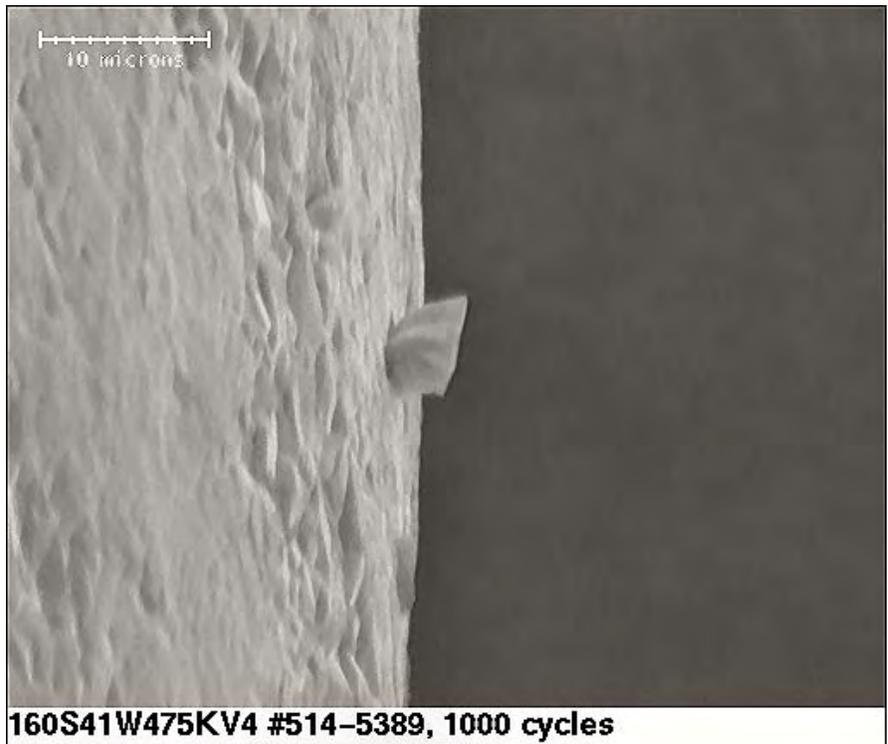
Sample 7 - right



Fig. 56

2500x magnification

Sample 7 - right



160S41W475KV4 – pre Temp Cycle

Fig. 57

250x magnification

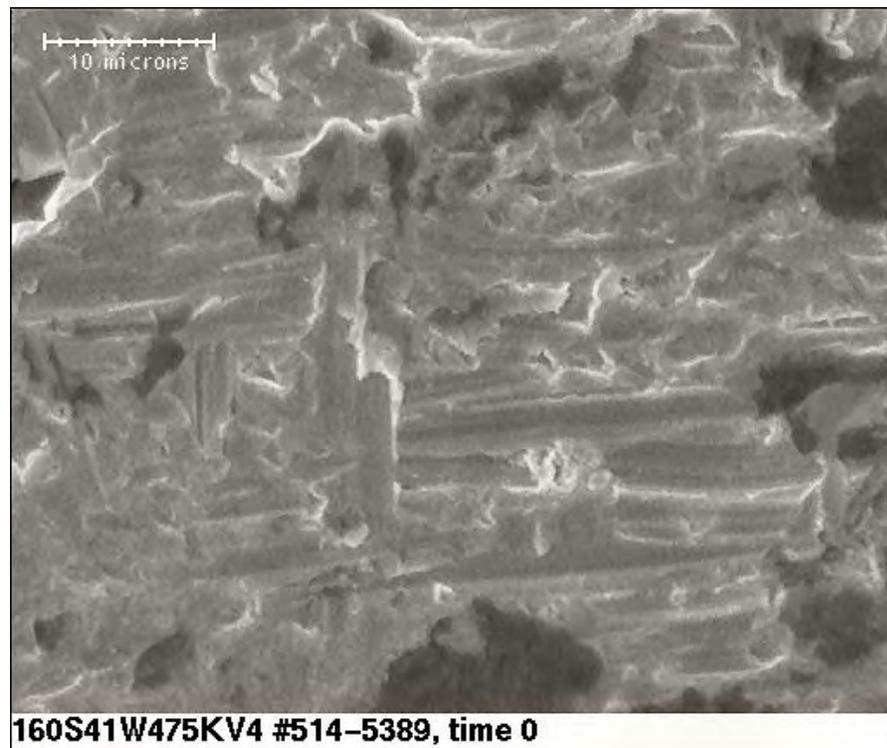
Sample 8 - left



Fig. 58

2500x magnification

Sample 8 - left



160S41W475KV4 - 1000 cycles

Fig. 59

250x magnification

Sample 8 - left

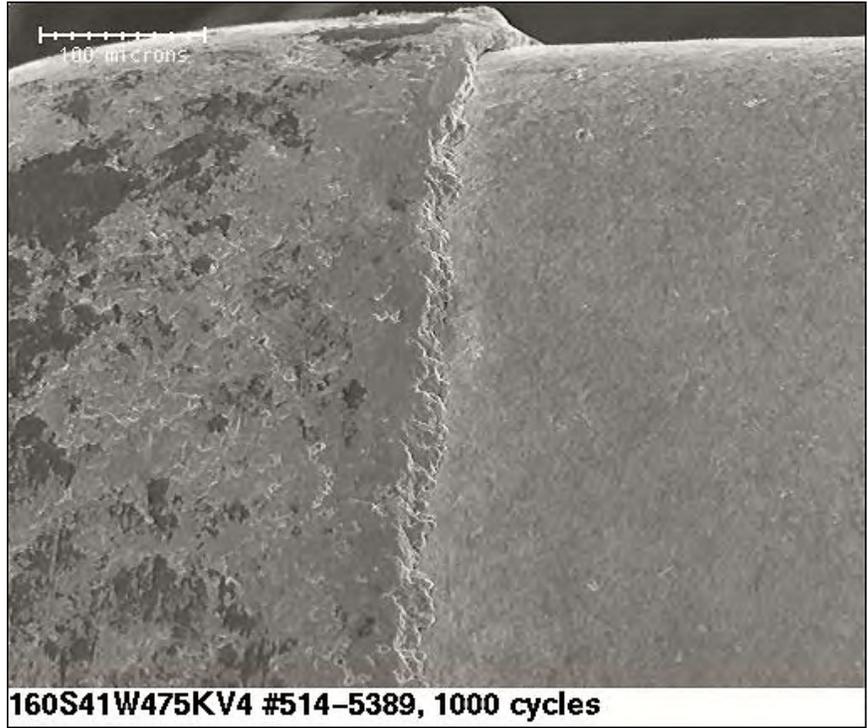
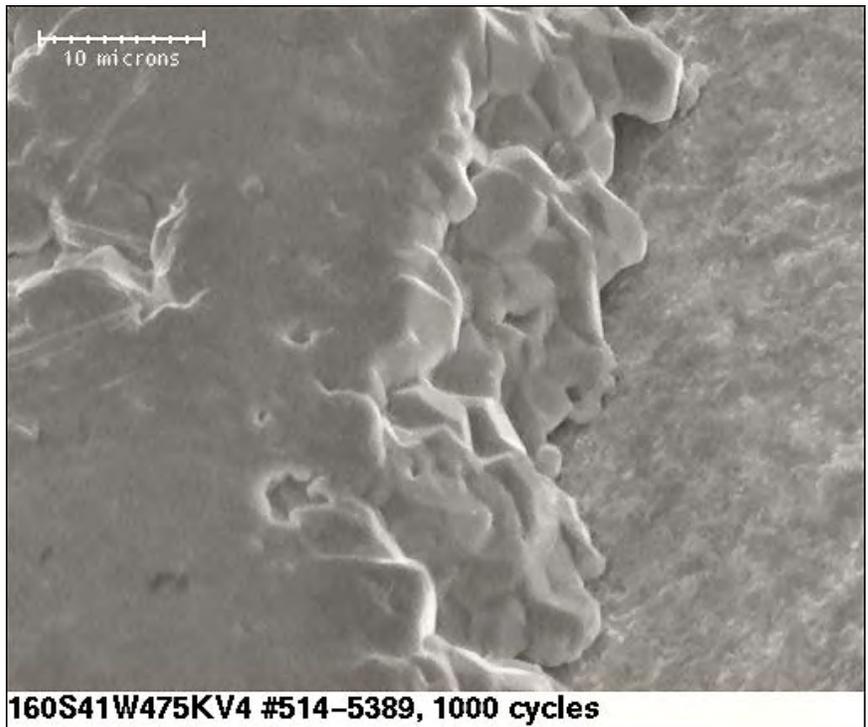


Fig. 60

2500x magnification

Sample 8 - left



160S41W475KV4 – pre Temp Cycle

Fig. 61

250x magnification

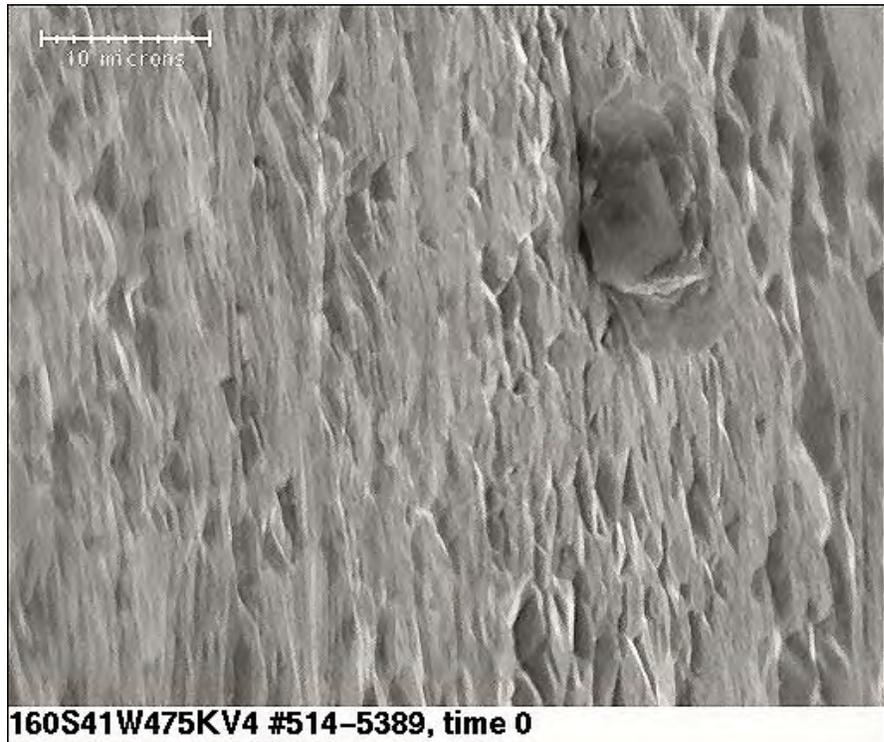
Sample 8 - right



Fig. 62

2500x magnification

Sample 8 - right



160S41W475KV4 - 1000 cycles

Fig. 63

250x magnification

Sample 8 - right

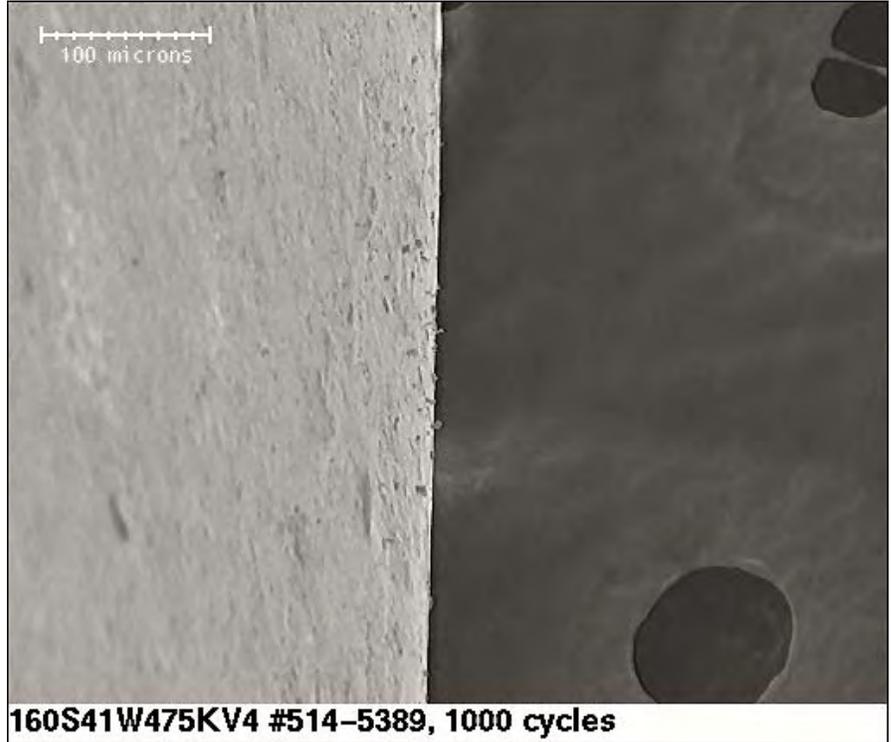
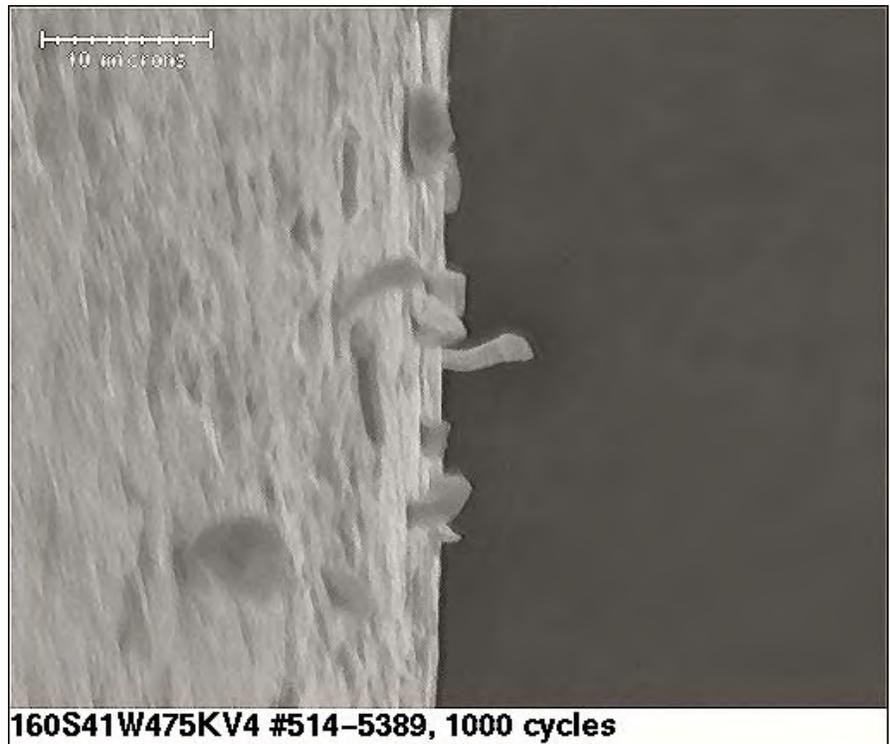


Fig. 64

2500x magnification

Sample 8 - right



160S41W475KV4 – pre Temp Cycle

Fig. 65

250x magnification

Sample 9 - left

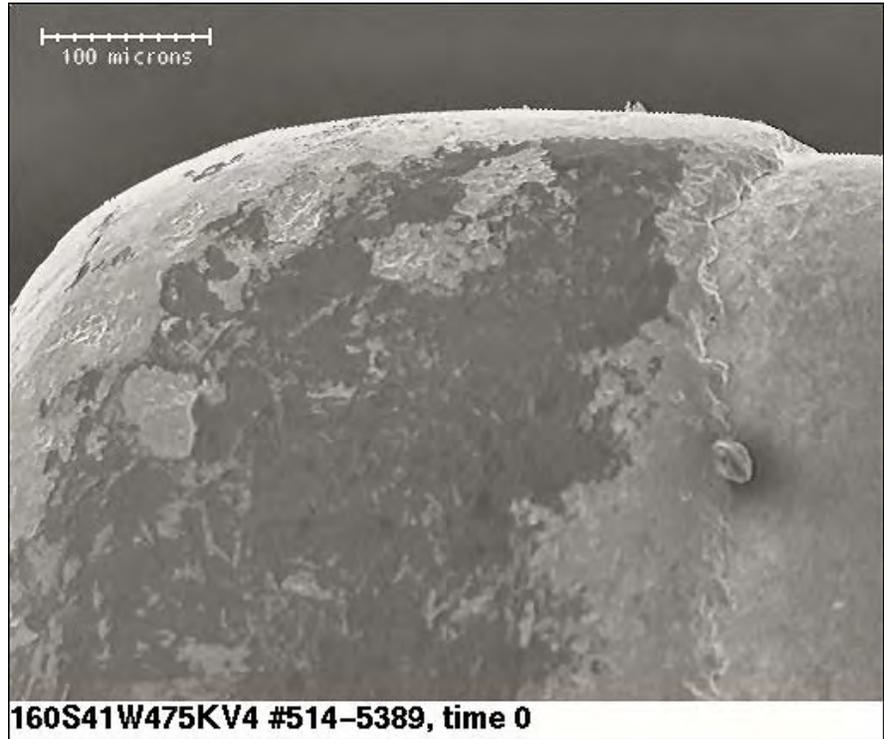


Fig. 66

2500x magnification

Sample 9 - left



160S41W475KV4 - 1000 cycles

Fig. 67

250x magnification

Sample 9 - left

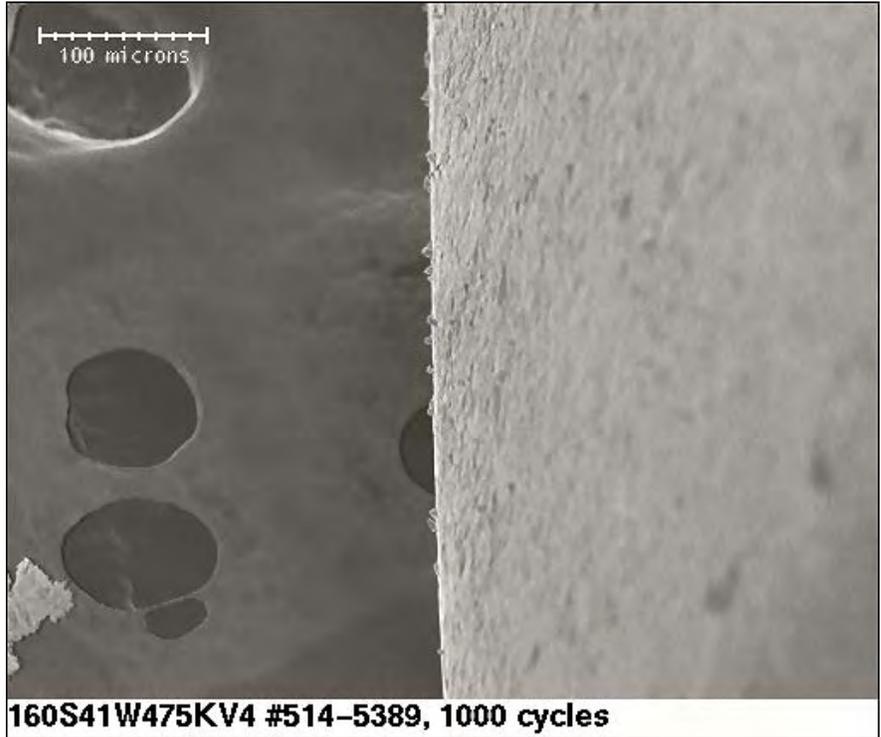
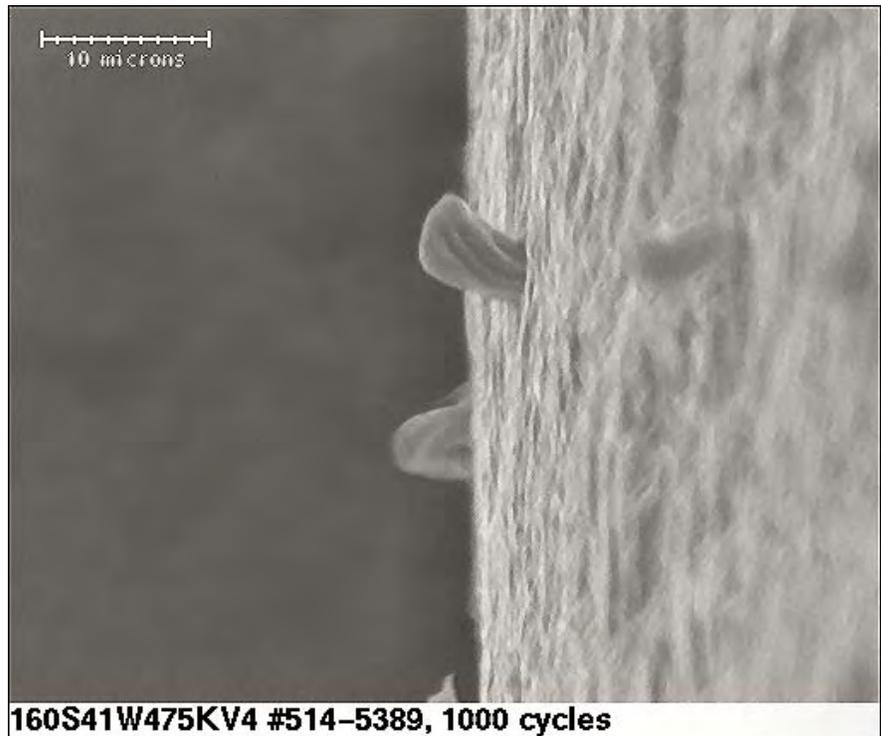


Fig. 68

2500x magnification

Sample 9 - left



160S41W475KV4 – pre Temp Cycle

Fig. 69

250x magnification

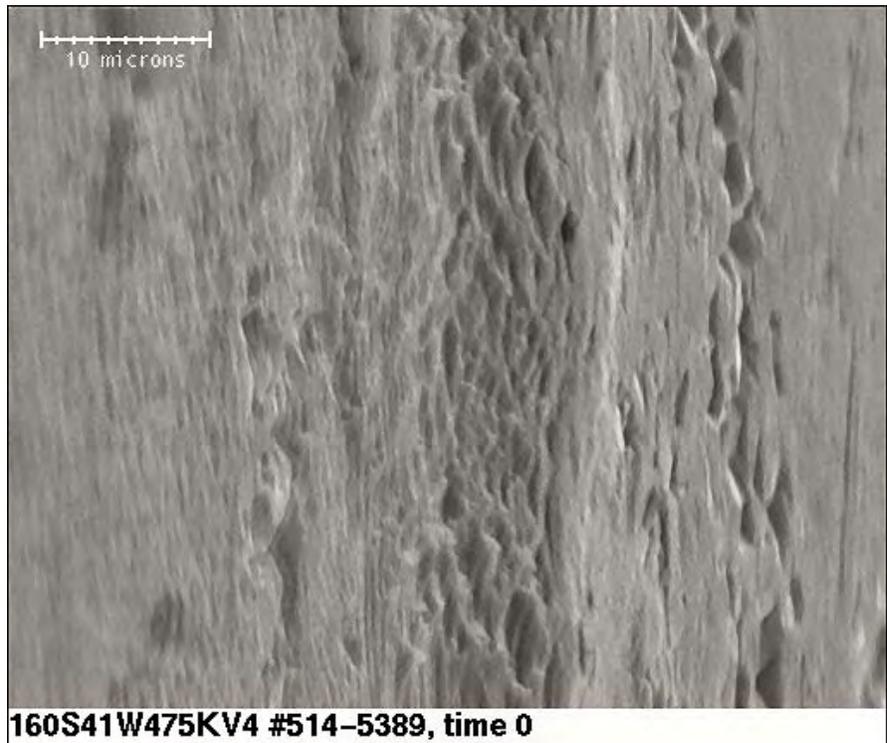
Sample 9 - right



Fig. 70

2500x magnification

Sample 9 - right



160S41W475KV4 - 1000 cycles

Fig. 71

250x magnification

Sample 9 - right

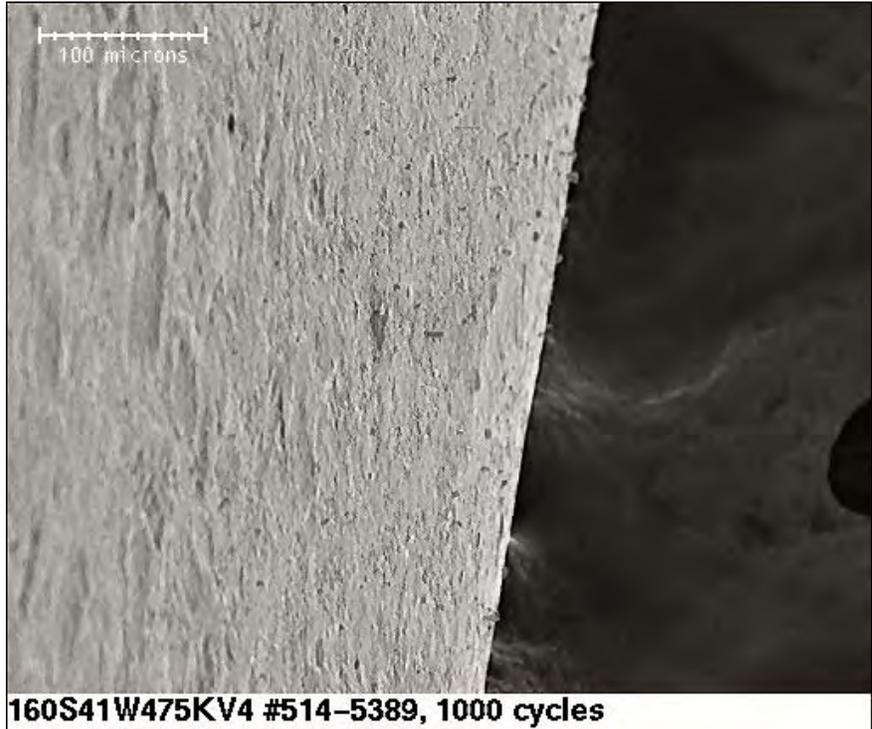


Fig. 72

2500x magnification

Sample 9 - right

