



**Subject: Laboratory Report # OEM138-001.3**  
**Submitter: Omar Al Taher, Johanson Dielectrics, Inc.**  
**Description: Tin Whisker Qualification by Temperature Cycle Stress, Part #500R15W473KV4 100% Sn**  
**Date: November 17, 2005**

Jeff Shearer  
 SEM Laboratory Manager  
 (610) 939-9500 x-37  
 e-mail [jshearer@siliconcert.com](mailto: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: **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 cycling stress. The capacitors were labeled ‘1’ through ‘15’. The terminations on each capacitor were labeled ‘left’ and ‘right’.
- No whiskers were observed ‘pre-temperature cycle stress’ on any of the 30 terminations.
- Representative images were made of 18 terminations before (pre) temperature cycle stress at magnifications of 250x and 2500x to show the general plating structure.
- All 30 terminations were inspected post-temperature cycling. Images were made of 18 terminations after 1000 cycle stress at magnifications of 250x and 2500x to document the longest tin whiskers, if present.
- The documented detailed inspection for tin whiskers\* on 18 selected terminations 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	no whiskers observed	N/A
1	right	2	no whiskers observed	N/A
3	left	3	4	N/A
3	right	4	no whiskers observed	N/A
5	left	5	no whiskers observed	N/A
5	right	6	no whiskers observed	N/A
7	left	7	no whiskers observed	N/A
7	right	8	no whiskers observed	N/A

<u>Capacitor #</u>	<u>Termination</u>	<u>Area #</u>	<u>Longest Whisker length (um)</u>	<u>Whisker Density</u>
9	left	9	no whiskers observed	N/A
9	right	10	no whiskers observed	N/A
10	left	11	2	N/A
10	right	12	3	N/A
12	left	13	2	N/A
12	right	14	no whiskers observed	N/A
13	left	15	3	N/A
13	right	16	no whiskers observed	N/A
15	left	17	no whiskers observed	N/A
15	right	18	no whiskers observed	N/A

\*\* Note: Whisker Density is based on observed whiskers 10um or more in length.

N/A indicates 'not applicable' since no whiskers >10um were observed

- Observed whiskers were of the 'straight' classification.
- All observed whiskers passed 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:**

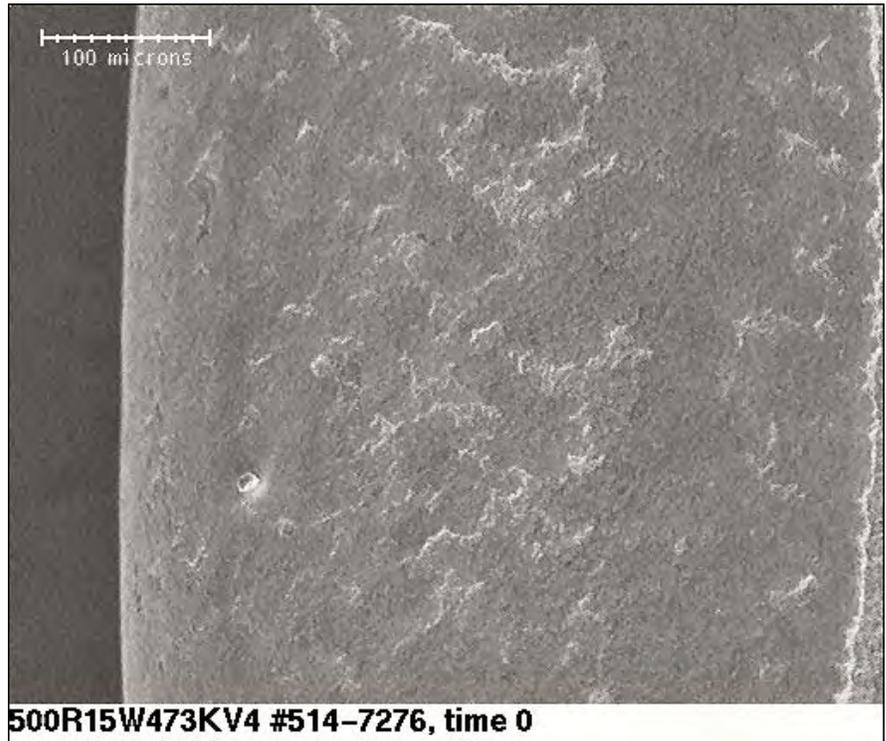
All devices examined within the capacitor group, **500R15W473KV4 lot #514-7276 100% Sn, 0805 size** and subjected to temperature cycling stress as certified by Silicon Cert Ltd. meet the acceptance requirements for Class 2 devices as stipulated by iNEMI 'Tin Whisker Acceptance Test Requirements', July 28, 2004, paragraph 18.2.3.

### 500R15W473KV4 – pre Temp Cycle

**Fig. 1**

**250x magnification**

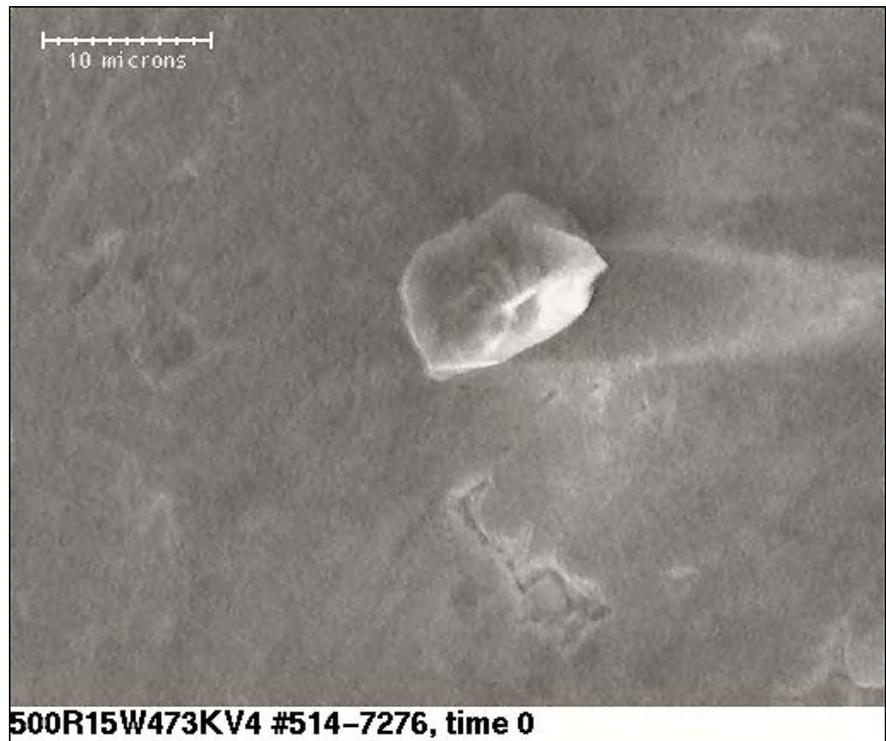
**Sample 1 - left**



**Fig. 2**

**2500x magnification**

**Sample 1 - left**

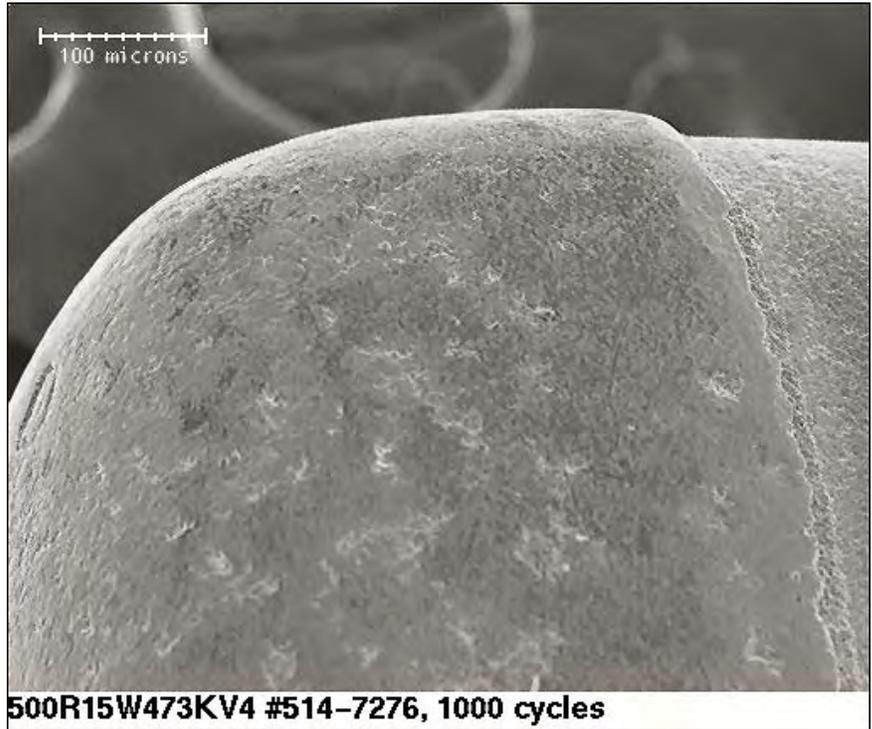


### 500R15W473KV4 - 1000 cycles

**Fig. 3**

**250x magnification**

**Sample 1 - left**



**Fig. 4**

**2500x magnification**

**Sample 1 - left**

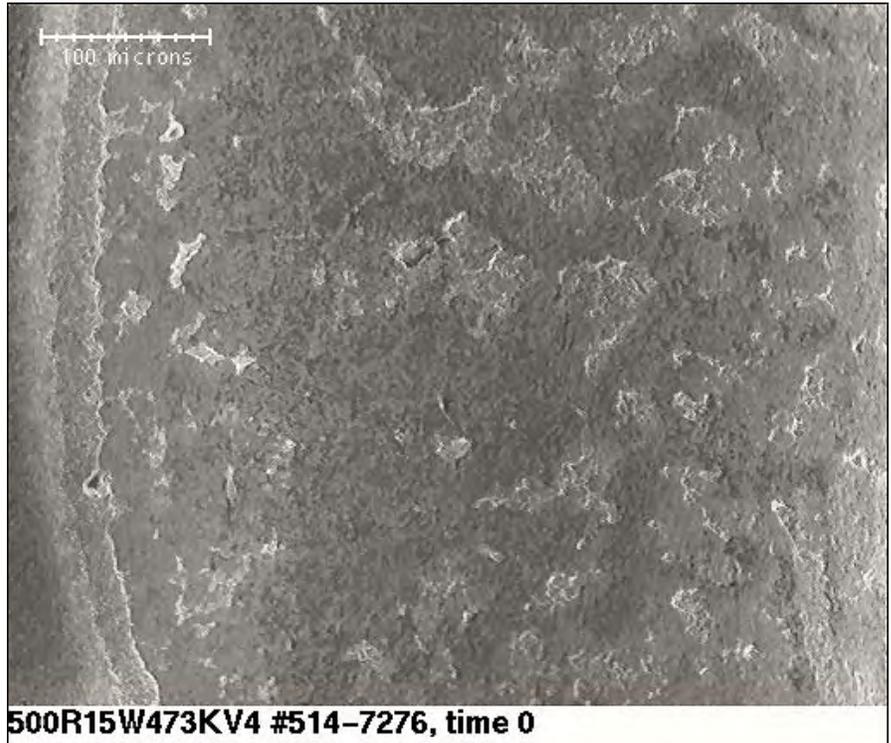


### 500R15W473KV4 – pre Temp Cycle

**Fig. 5**

**250x magnification**

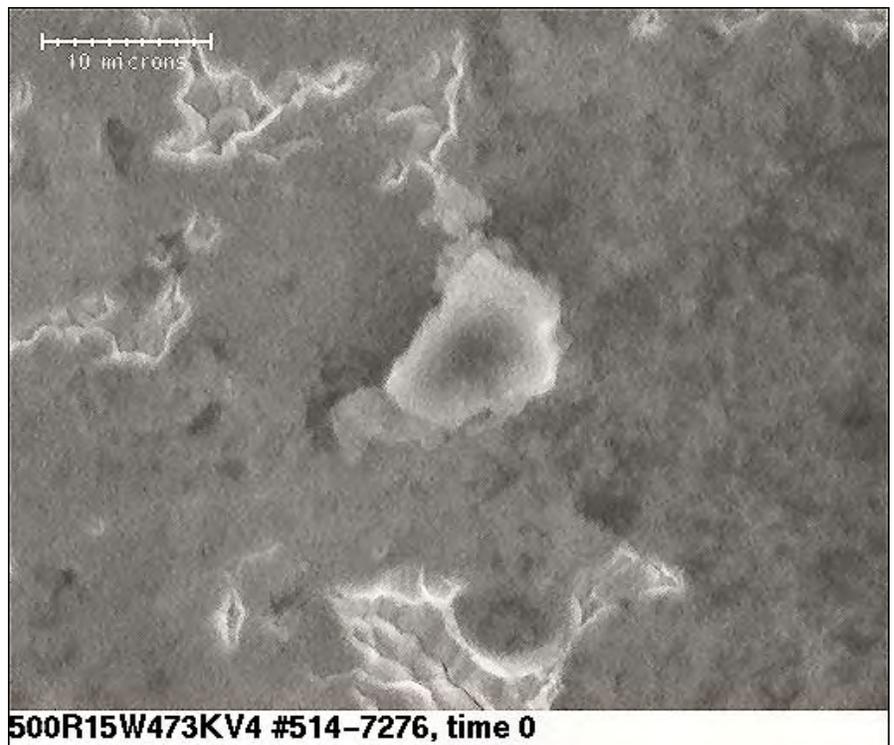
**Sample 1 - right**



**Fig. 6**

**2500x magnification**

**Sample 1 - right**

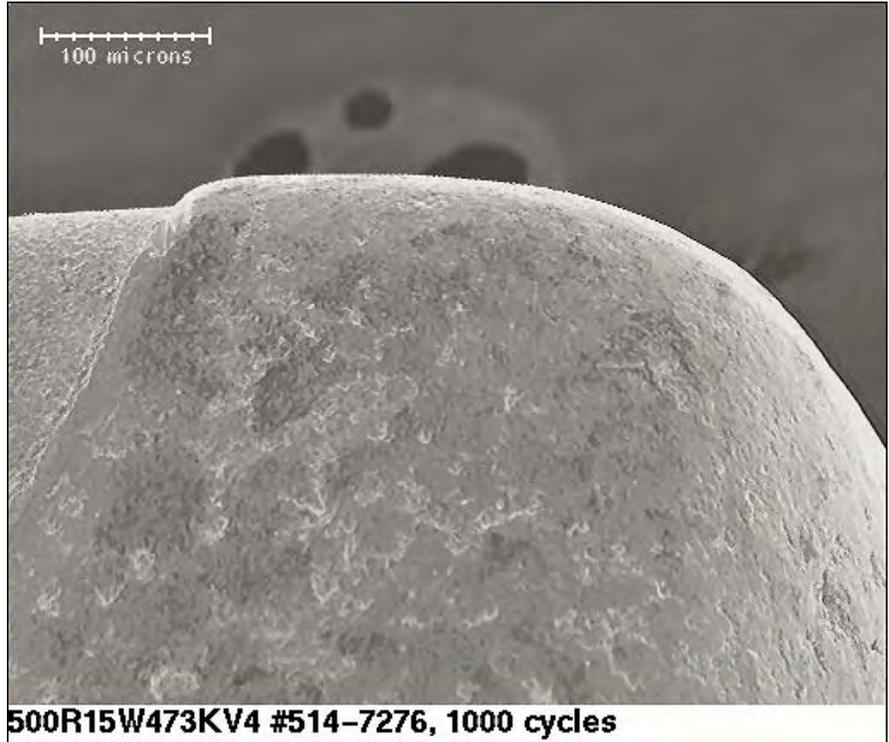


**500R15W473KV4 - 1000 cycles**

**Fig. 7**

**250x magnification**

**Sample 1 - right**



**Fig. 8**

**2500x magnification**

**Sample 1 - right**



### 500R15W473KV4 – pre Temp Cycle

**Fig. 9**

**250x magnification**

**Sample 3 - left**



**Fig. 10**

**2500x magnification**

**Sample 3 - left**

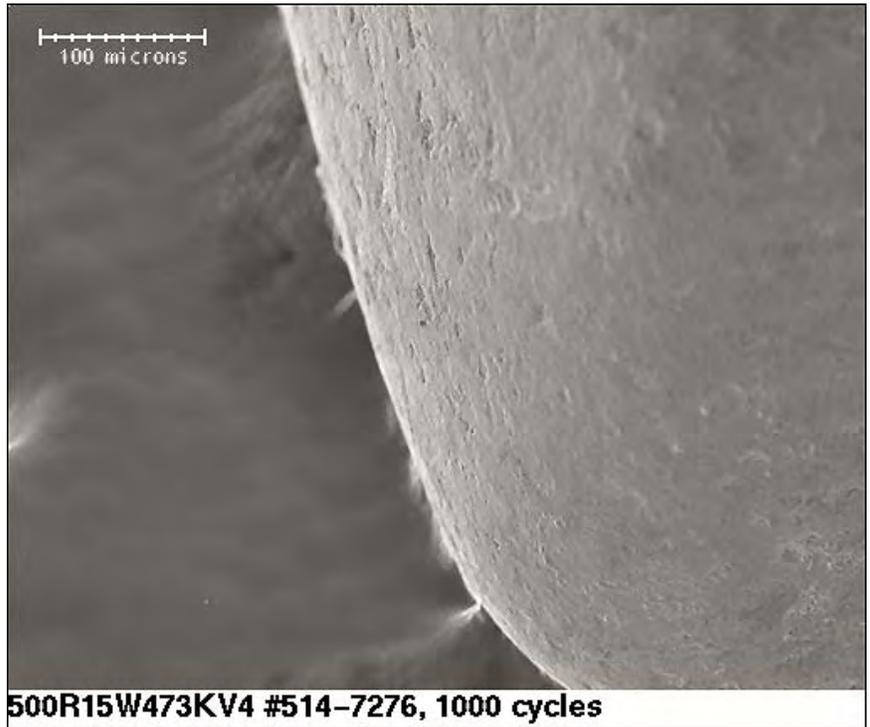


**500R15W473KV4 - 1000 cycles**

**Fig. 11**

**250x magnification**

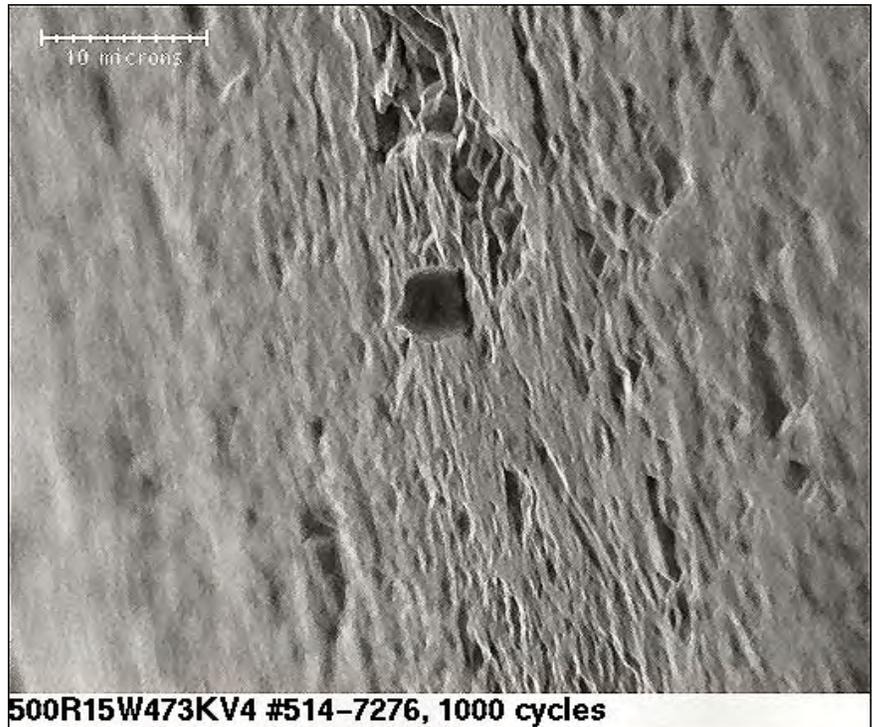
**Sample 3 - left**



**Fig. 12**

**2500x magnification**

**Sample 3 - left**

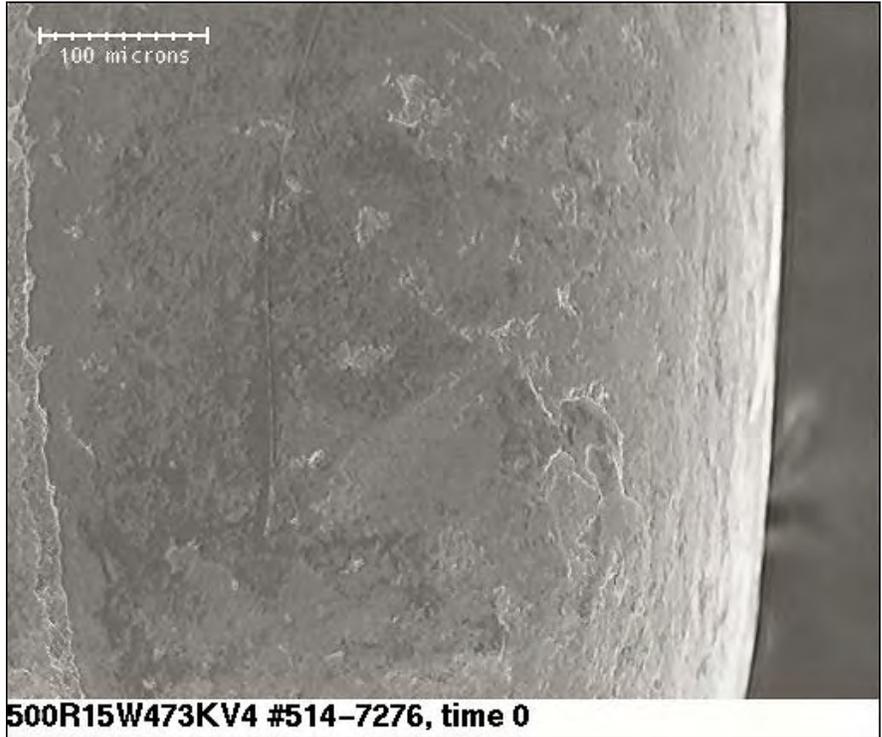


### 500R15W473KV4 – pre Temp Cycle

**Fig. 13**

**250x magnification**

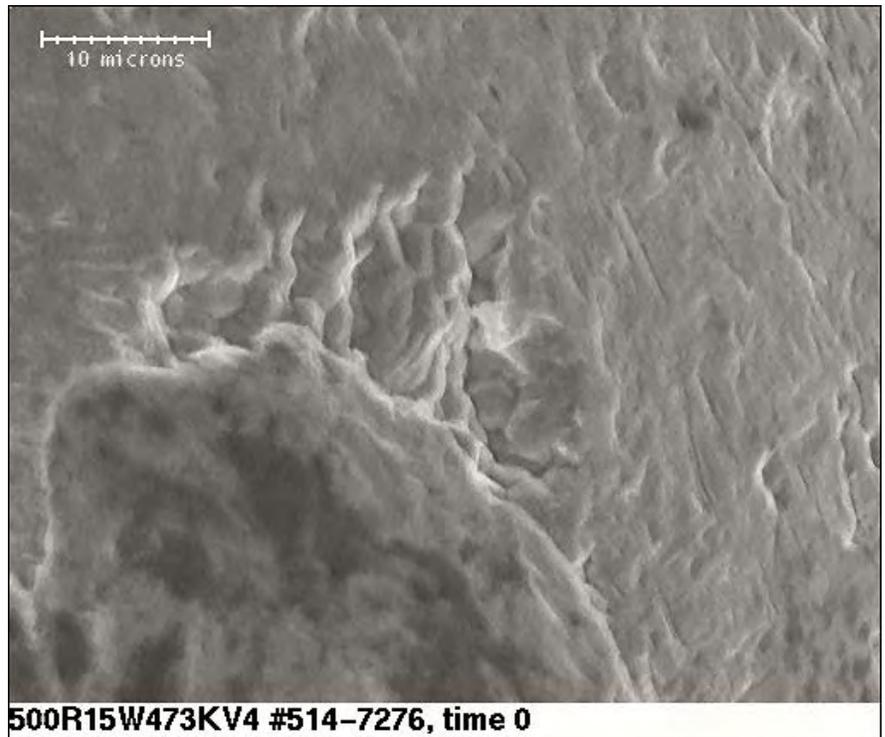
**Sample 3 - right**



**Fig. 14**

**2500x magnification**

**Sample 3 - right**



**500R15W473KV4 - 1000 cycles**

**Fig. 15**

**250x magnification**

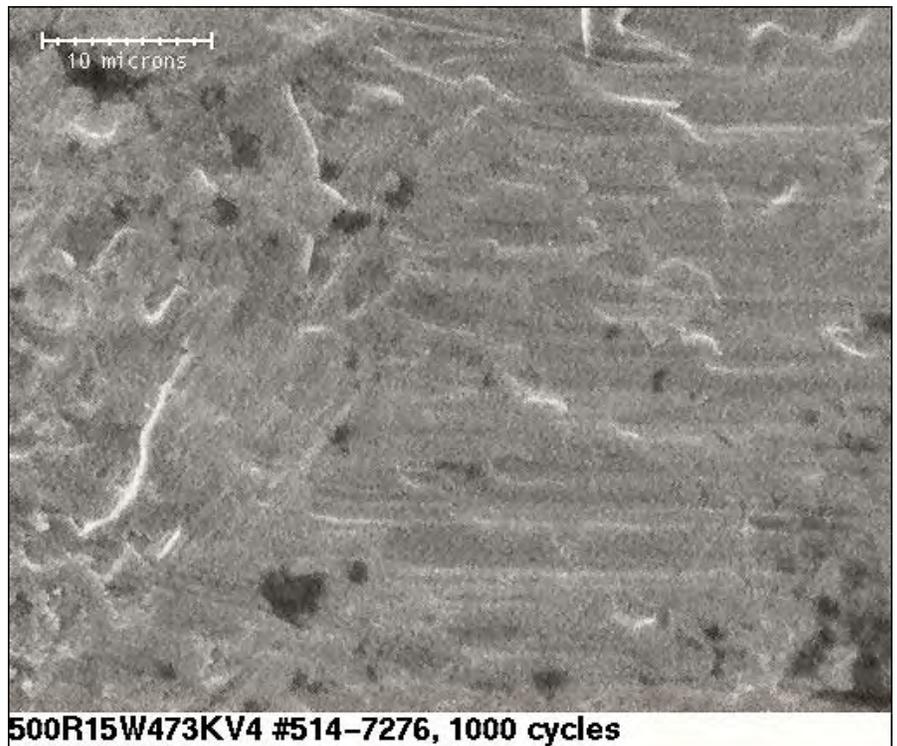
**Sample 3 - right**



**Fig. 16**

**2500x magnification**

**Sample 3 - right**



### 500R15W473KV4 – pre Temp Cycle

**Fig. 17**

**250x magnification**

**Sample 5 - left**



**Fig. 18**

**2500x magnification**

**Sample 5 - left**

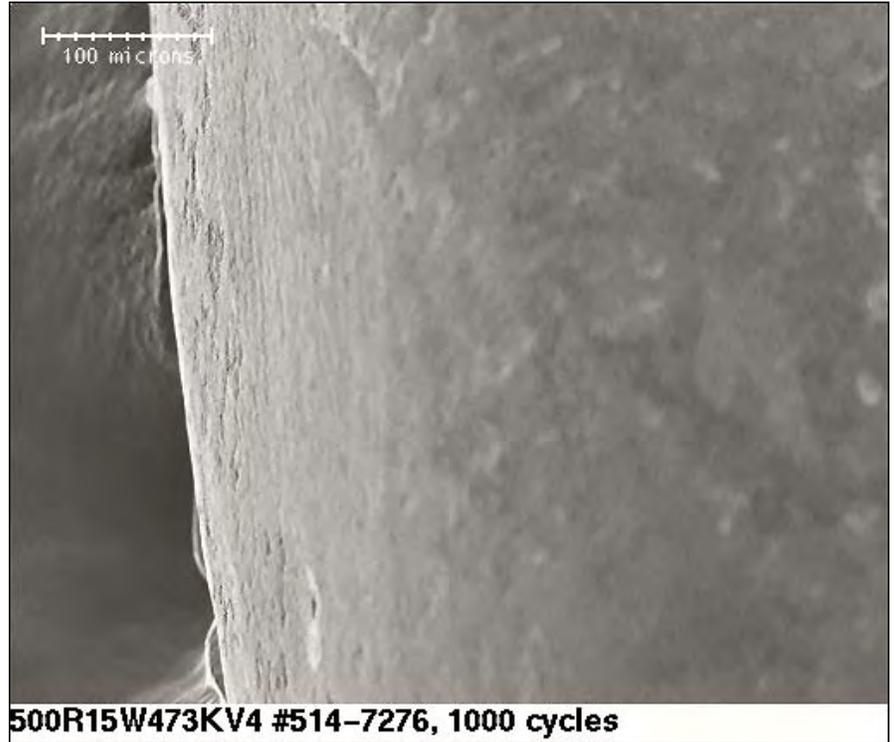


**500R15W473KV4 - 1000 cycles**

**Fig. 19**

**250x magnification**

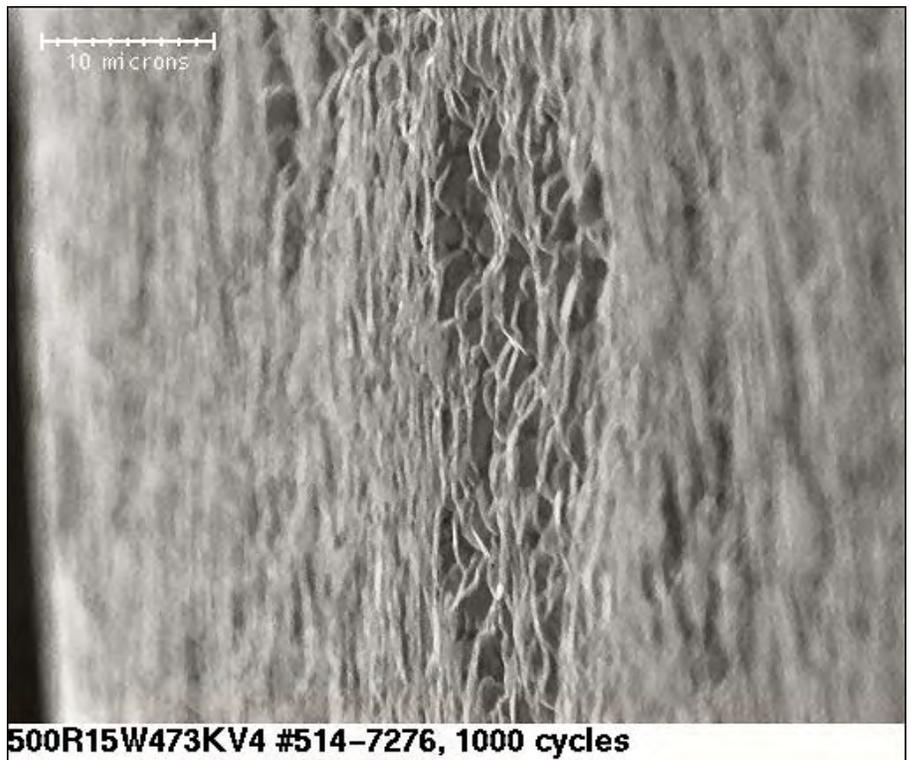
**Sample 5 - left**



**Fig. 20**

**2500x magnification**

**Sample 5 - left**

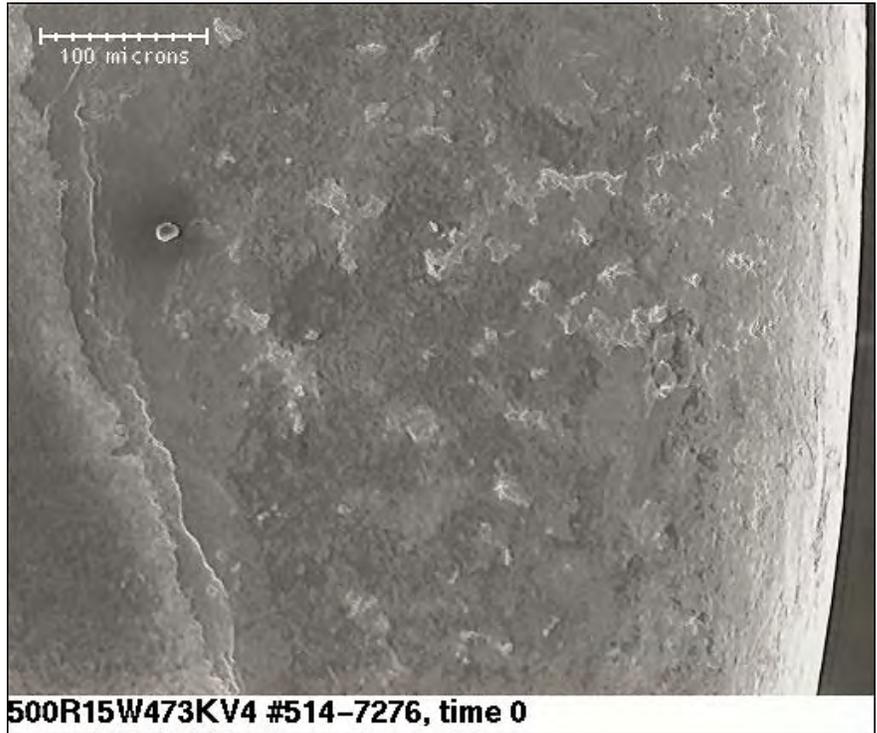


### 500R15W473KV4 – pre Temp Cycle

**Fig. 21**

**250x magnification**

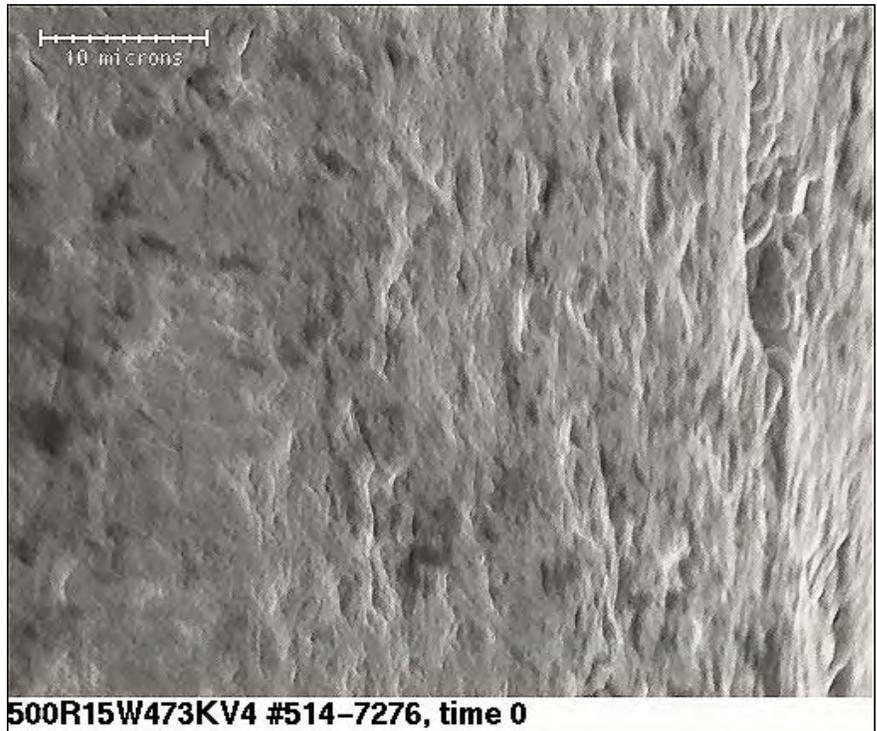
**Sample 5 - right**



**Fig. 22**

**2500x magnification**

**Sample 5 - right**



### 500R15W473KV4 - 1000 cycles

Fig. 23

250x magnification

Sample 5 - right

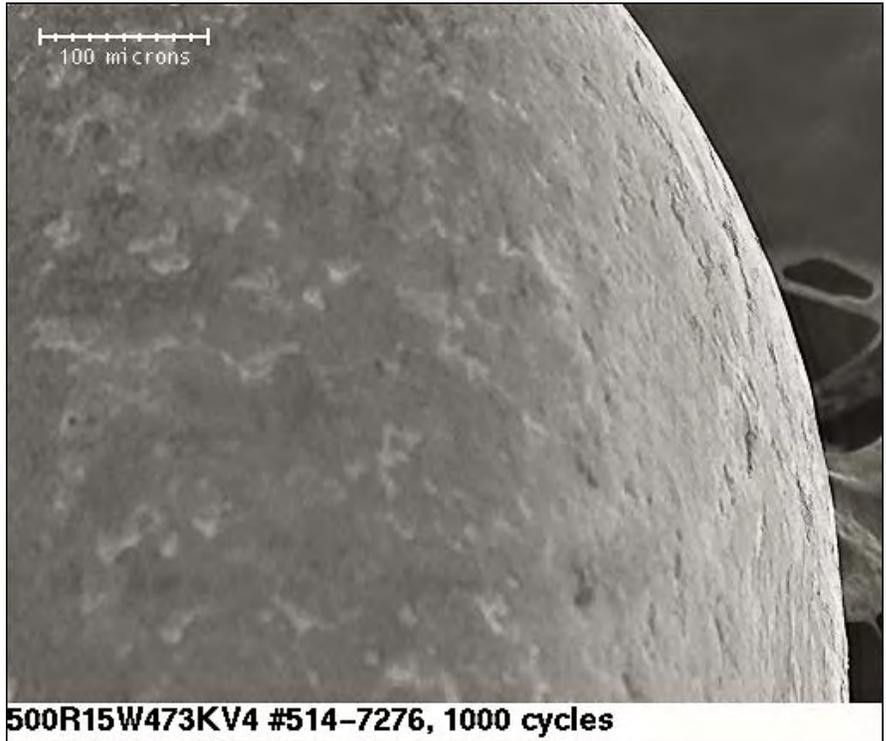


Fig. 24

2500x magnification

Sample 5 - right



### 500R15W473KV4 – pre Temp Cycle

Fig. 25

250x magnification

Sample 7 - left

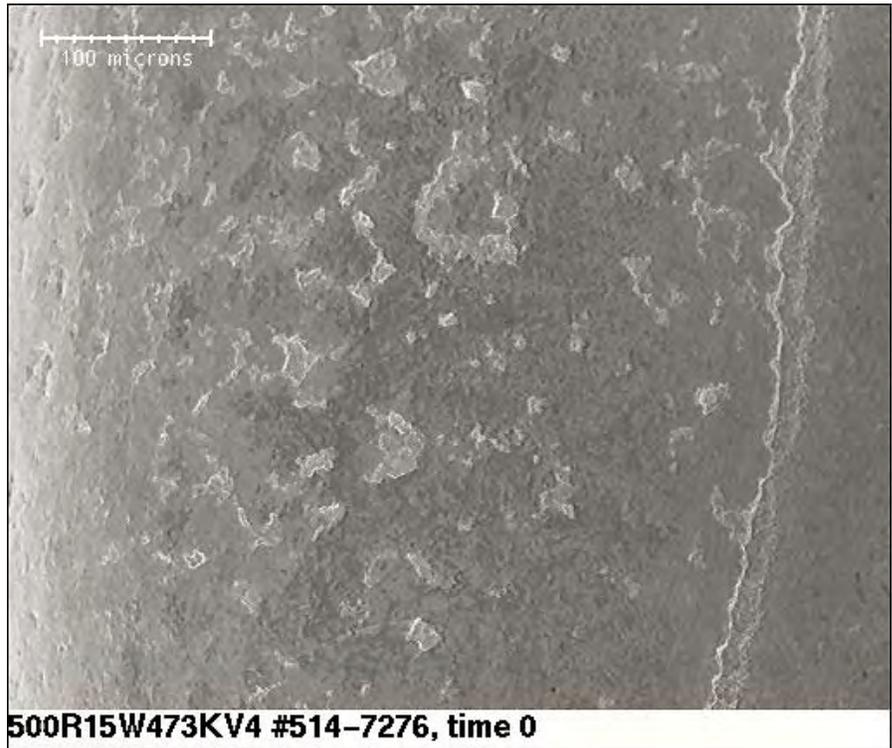
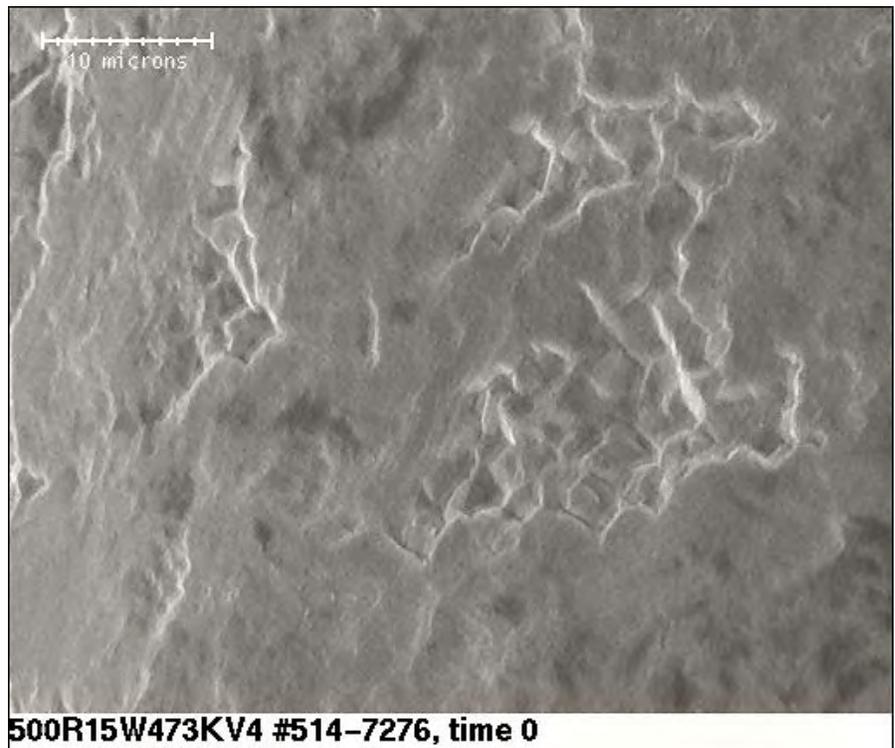


Fig. 26

2500x magnification

Sample 7 - left



**500R15W473KV4 - 1000 cycles**

**Fig. 27**

**250x magnification**

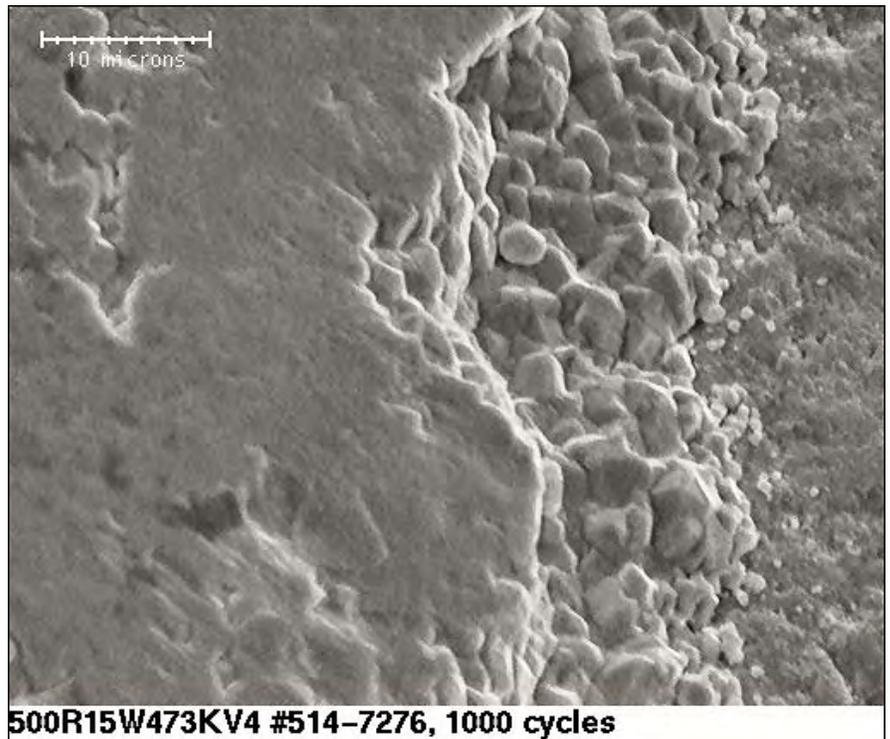
**Sample 7 - left**



**Fig. 28**

**2500x magnification**

**Sample 7 - left**

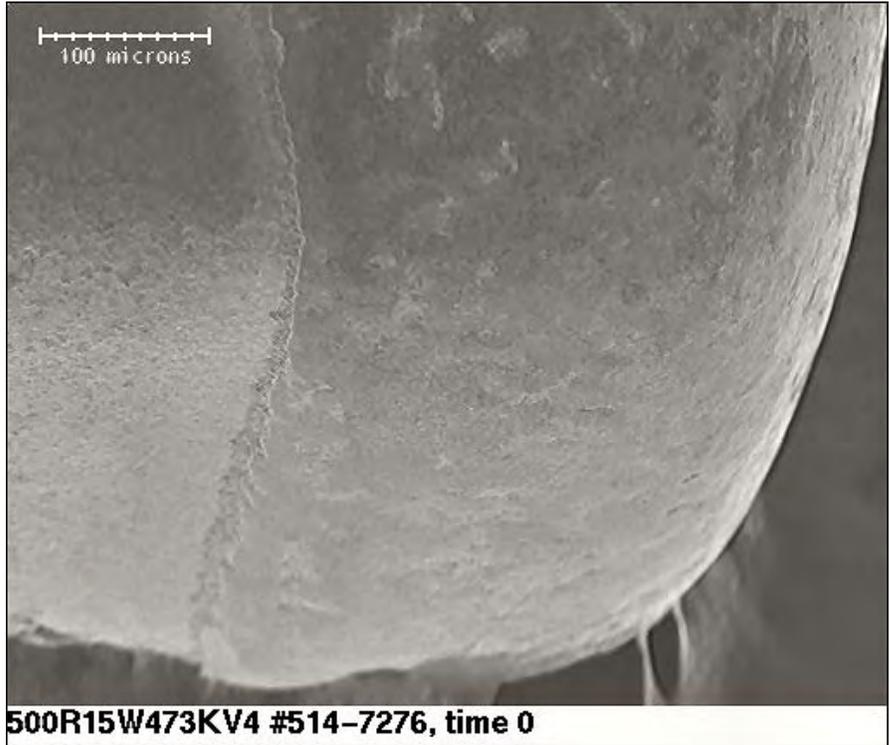


### 500R15W473KV4 – pre Temp Cycle

**Fig. 29**

**250x magnification**

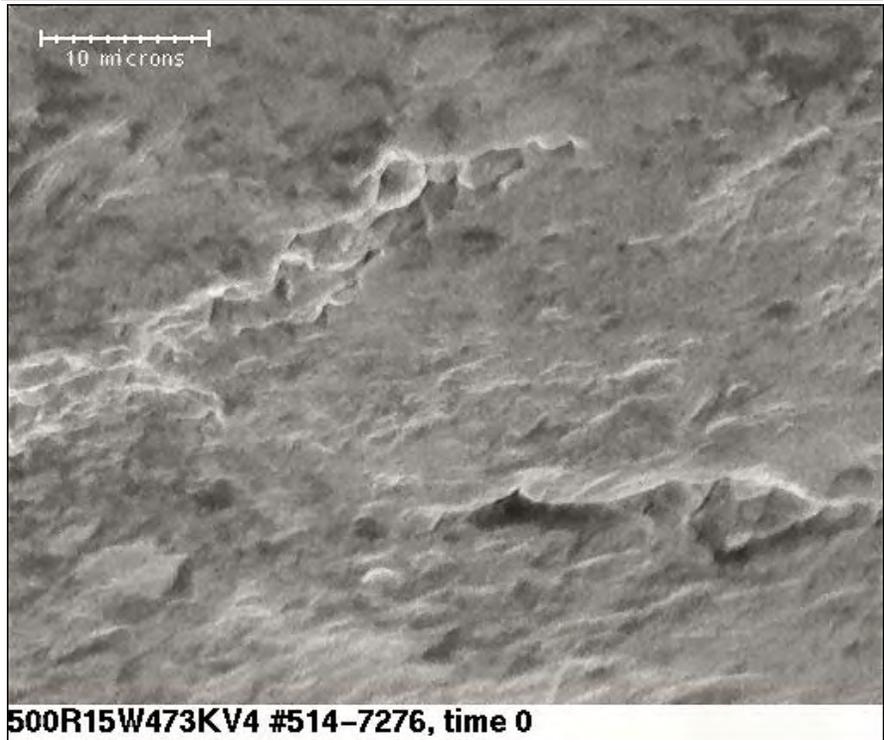
**Sample 7 - right**



**Fig. 30**

**2500x magnification**

**Sample 7 - right**

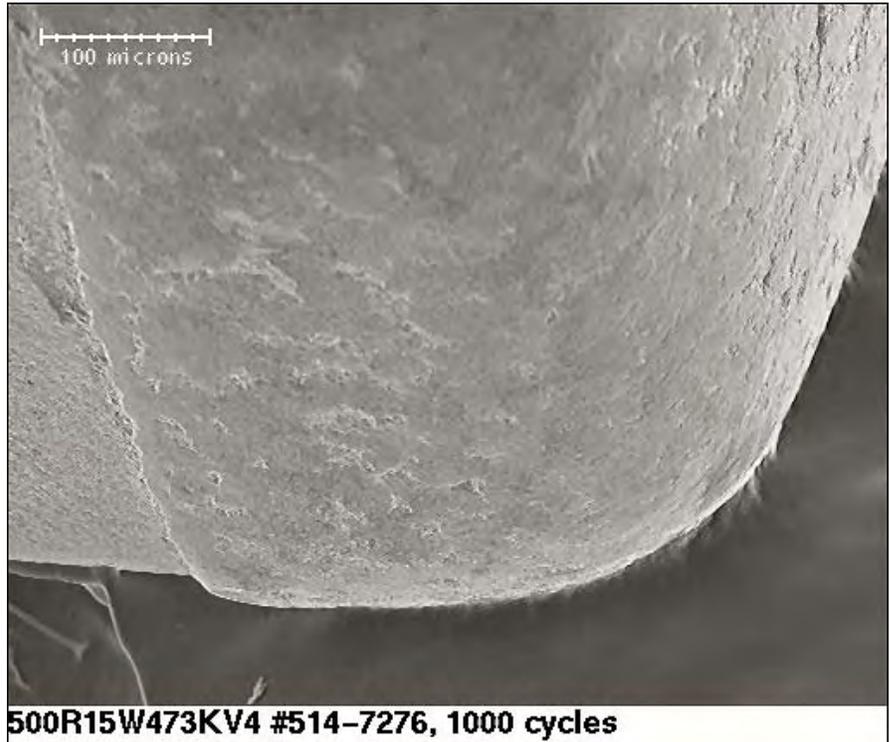


**500R15W473KV4 - 1000 cycles**

**Fig. 31**

**250x magnification**

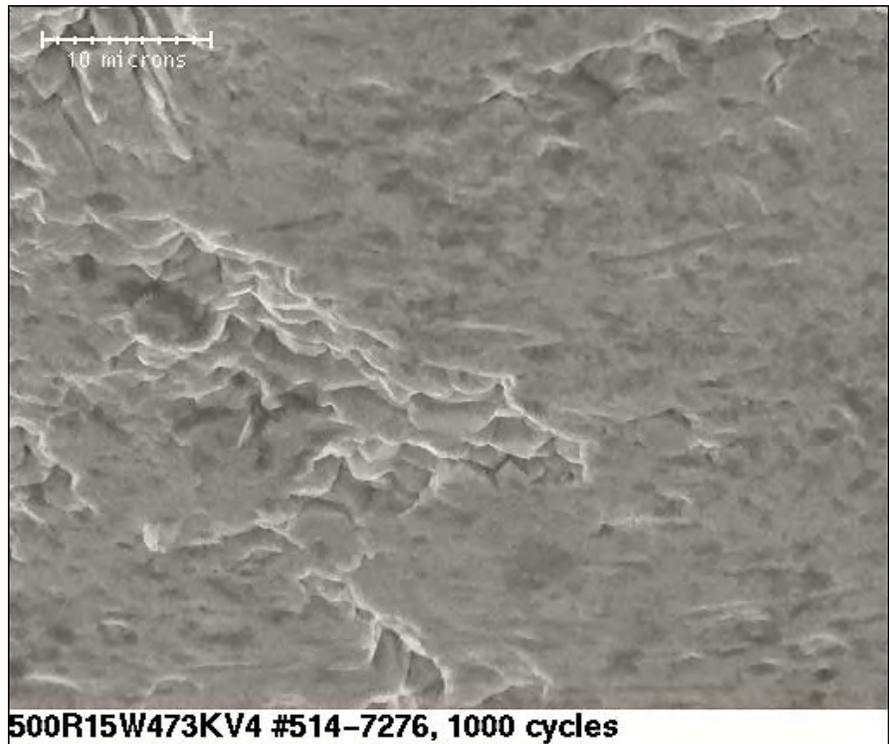
**Sample 7 - right**



**Fig. 32**

**2500x magnification**

**Sample 7 - right**



### 500R15W473KV4 – pre Temp Cycle

Fig. 33

250x magnification

Sample 8 - left

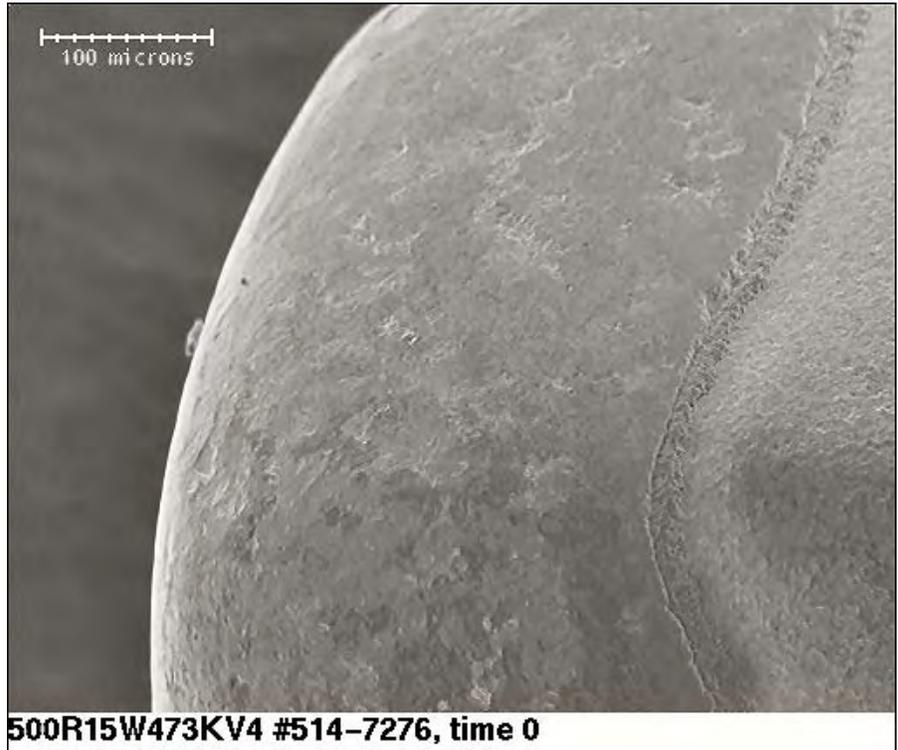


Fig. 34

2500x magnification

Sample 8 - left

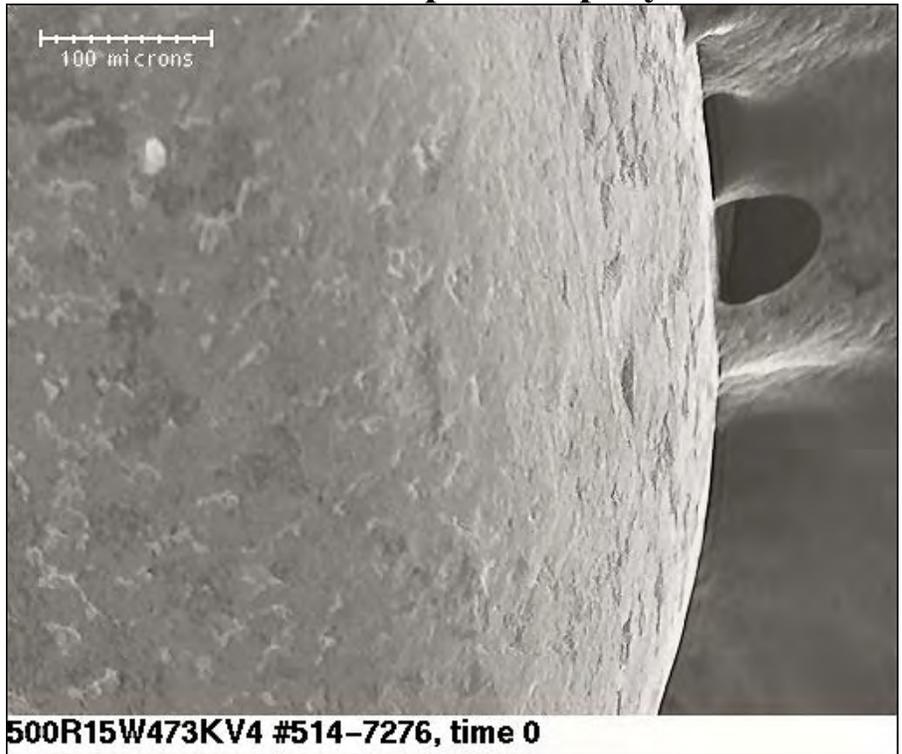


**500R15W473KV4 – pre Temp Cycle**

**Fig. 35**

**250x magnification**

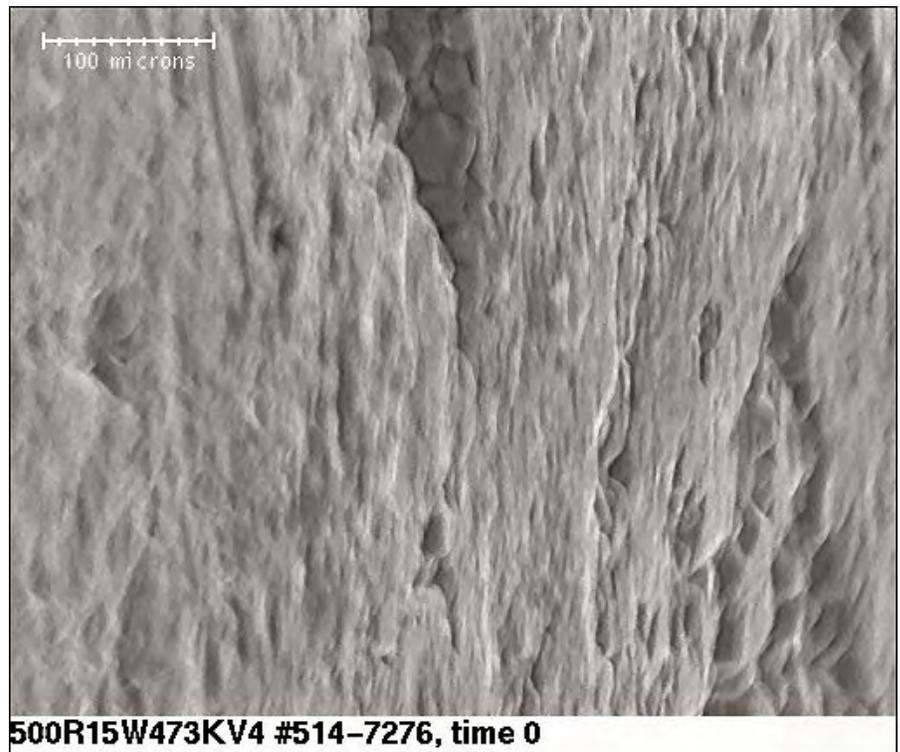
**Sample 8 - right**



**Fig. 36**

**2500x magnification**

**Sample 8 - right**

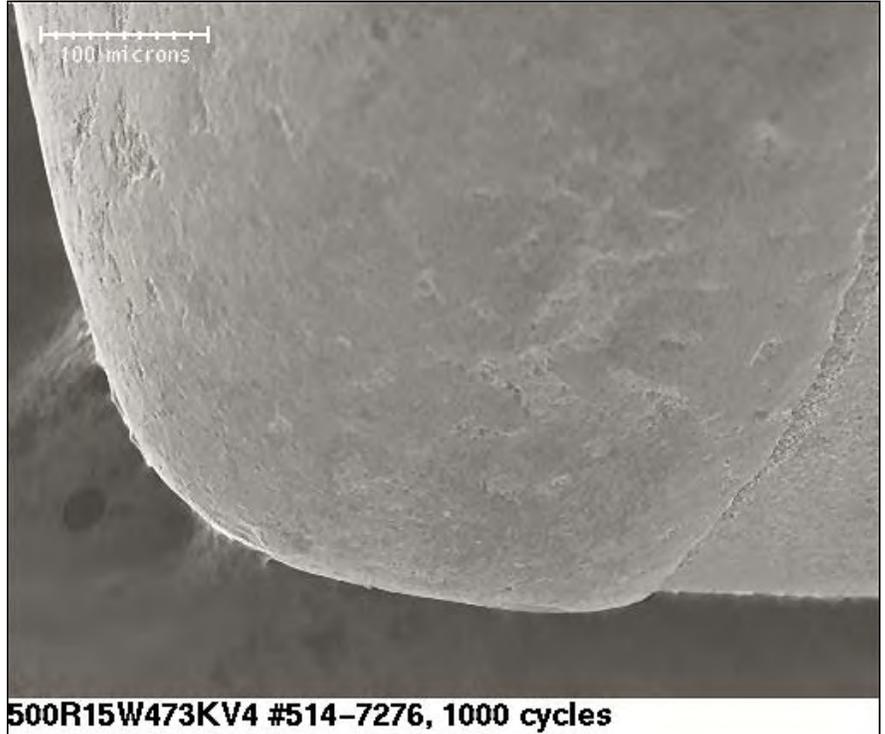


**500R15W473KV4 - 1000 cycles**

**Fig. 37**

**250x magnification**

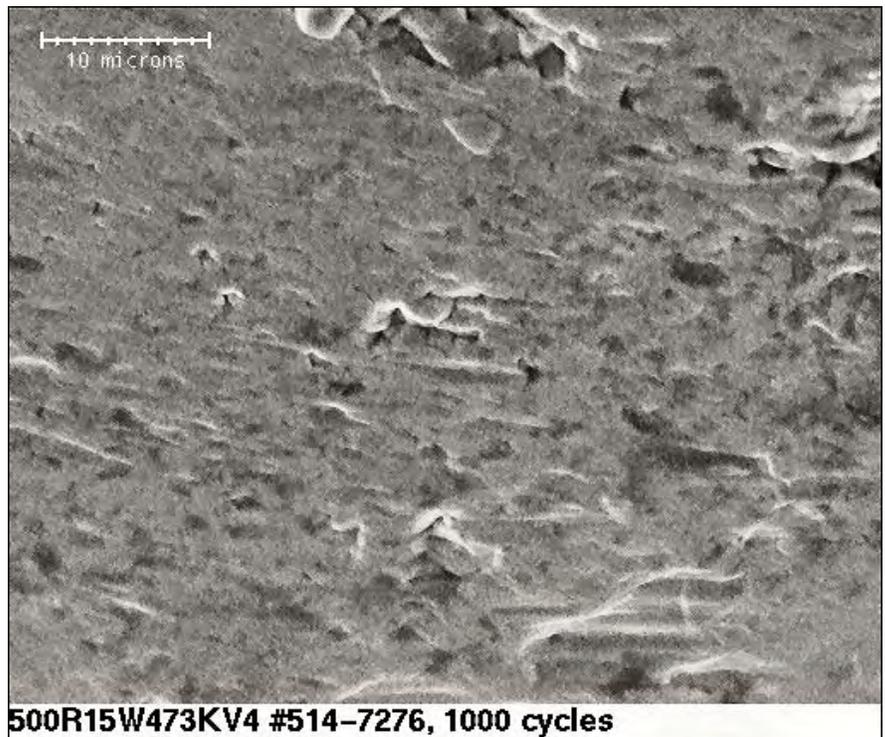
**Sample 9 - left**



**Fig. 38**

**2500x magnification**

**Sample 9 - left**



**500R15W473KV4 - 1000 cycles**

**Fig. 39**

**250x magnification**

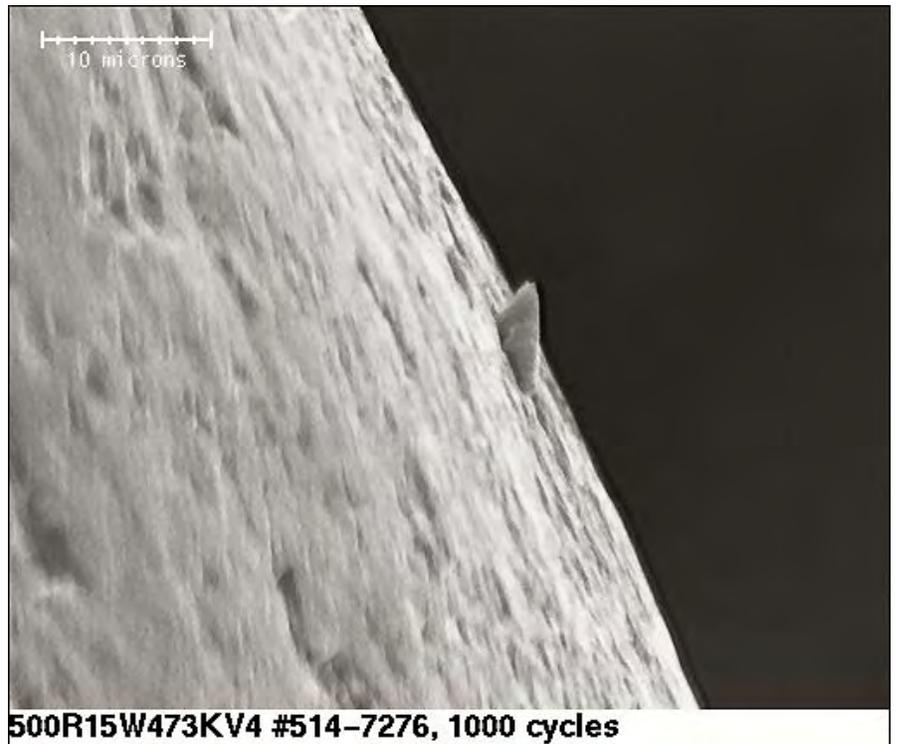
**Sample 9 - right**



**Fig. 40**

**2500x magnification**

**Sample 9 - right**

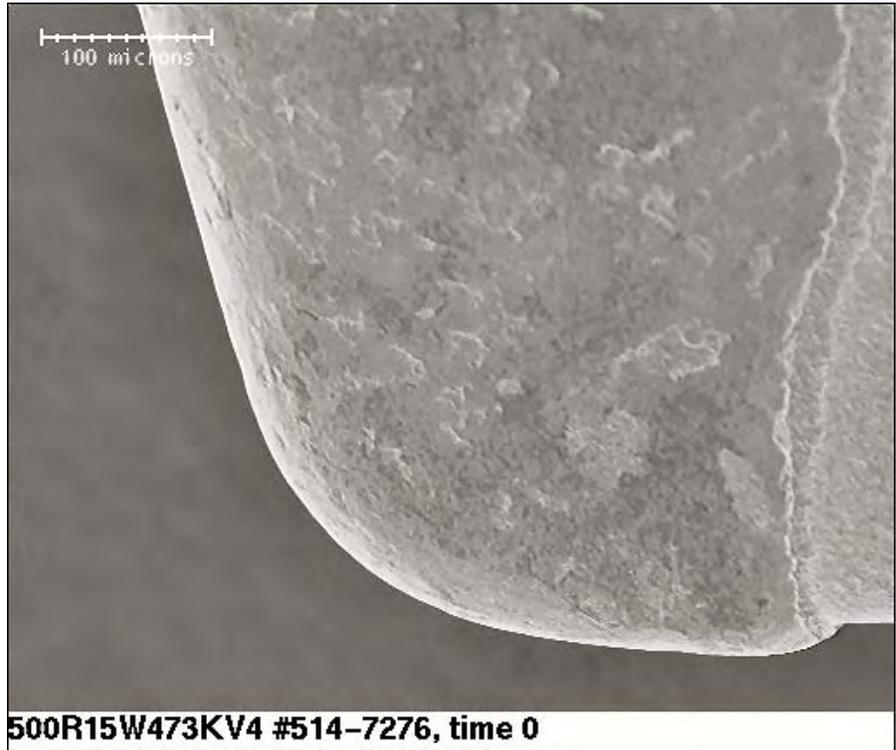


**500R15W473KV4 – pre Temp Cycle**

**Fig. 41**

**250x magnification**

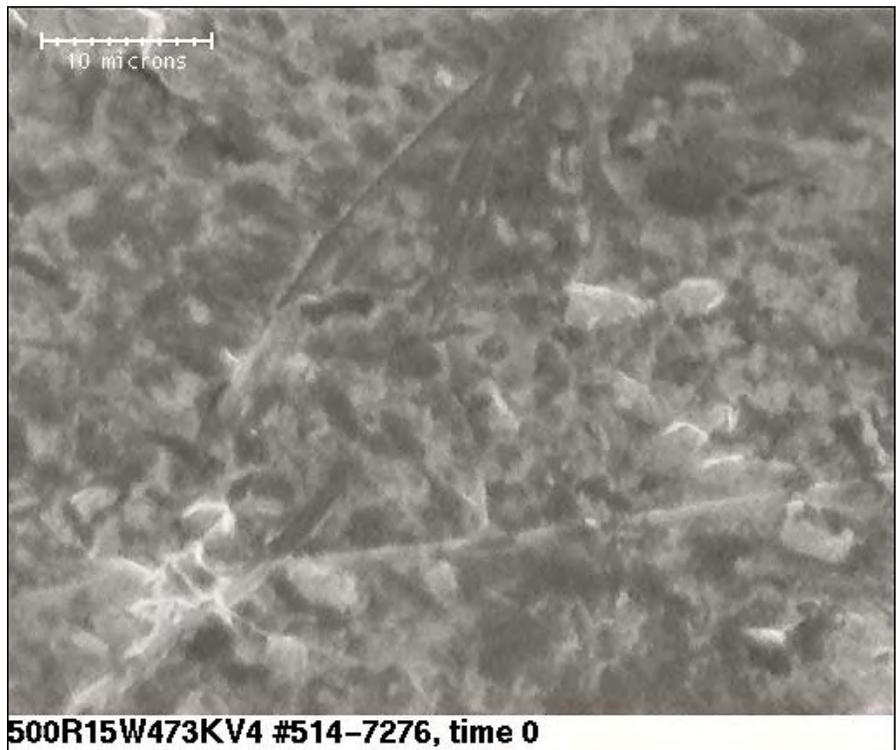
**Sample 10 - left**



**Fig. 42**

**2500x magnification**

**Sample 10 - left**

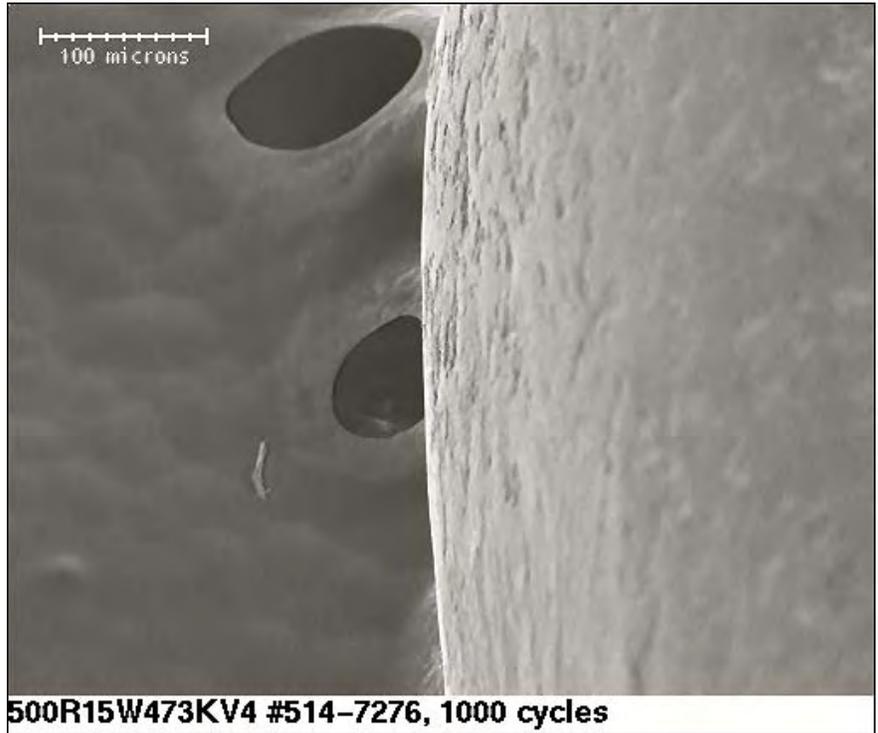


**500R15W473KV4 - 1000 cycles**

**Fig. 43**

**250x magnification**

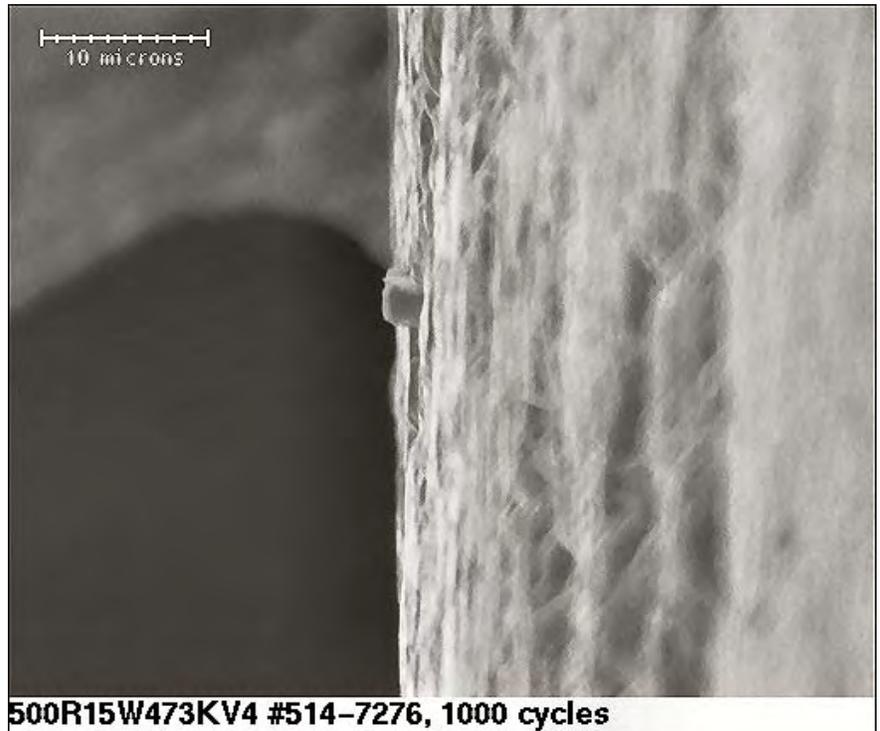
**Sample 10 - left**



**Fig. 44**

**2500x magnification**

**Sample 10 - left**



### 500R15W473KV4 – pre Temp Cycle

Fig. 45

250x magnification

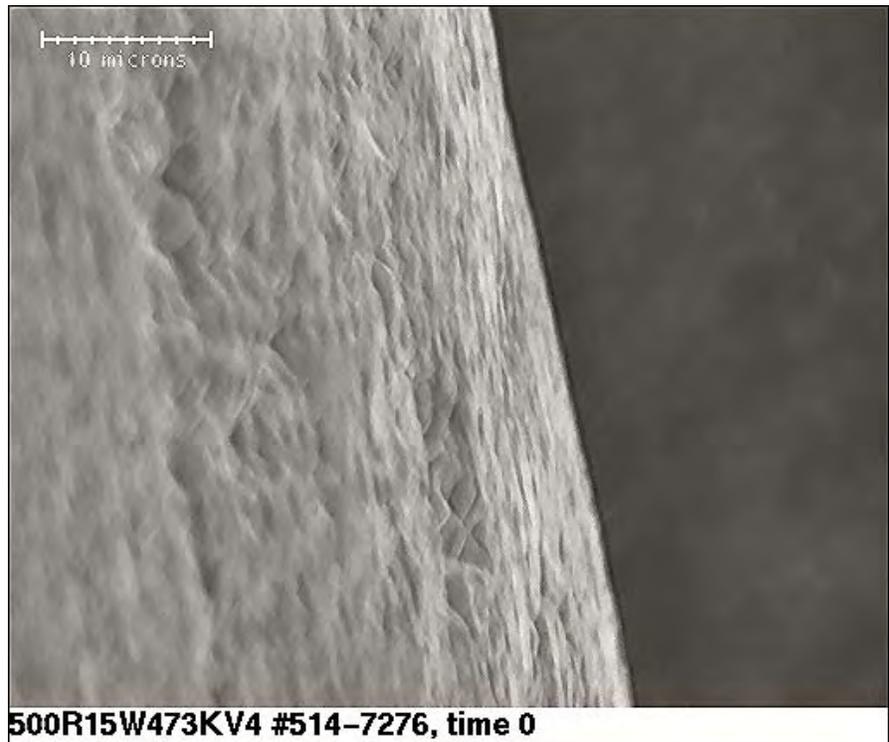
Sample 10 - right



Fig. 46

2500x magnification

Sample 10 - right

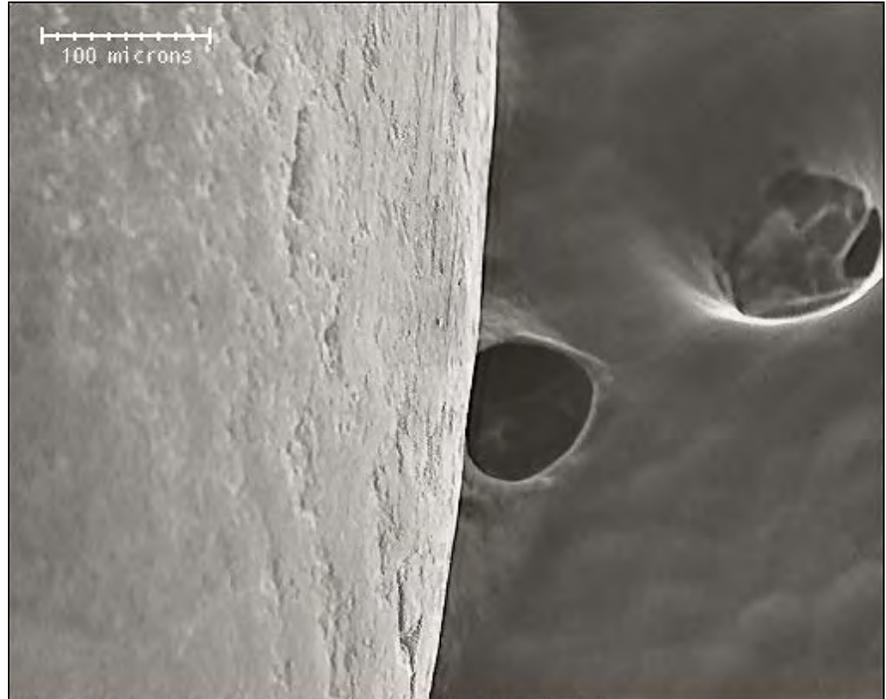


**500R15W473KV4 - 1000 cycles**

**Fig. 47**

**250x magnification**

**Sample 10 - right**

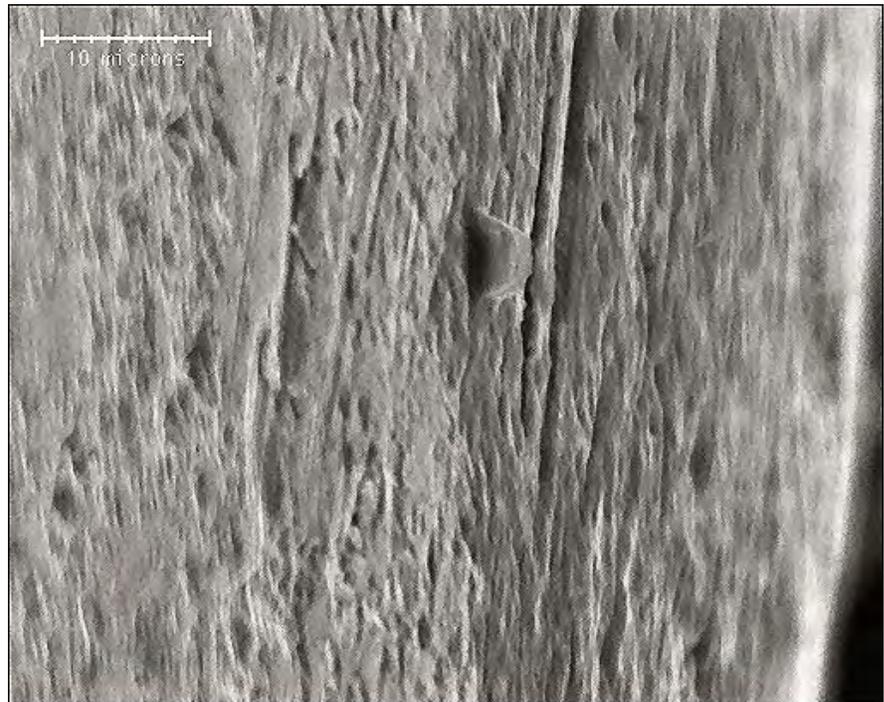


**500R15W473KV4 #514-7276, 1000 cycles**

**Fig. 48**

**2500x magnification**

**Sample 10 - right**



**500R15W473KV4 #514-7276, 1000 cycles**

### 500R15W473KV4 – pre Temp Cycle

**Fig. 49**

**250x magnification**

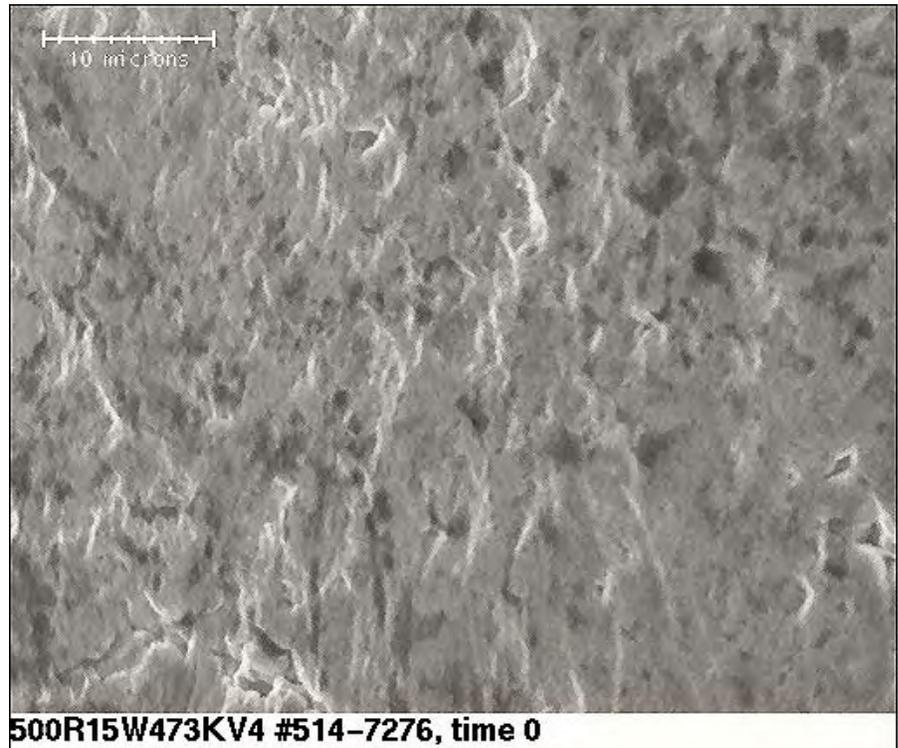
**Sample 11 - left**



**Fig. 50**

**2500x magnification**

**Sample 11 - left**

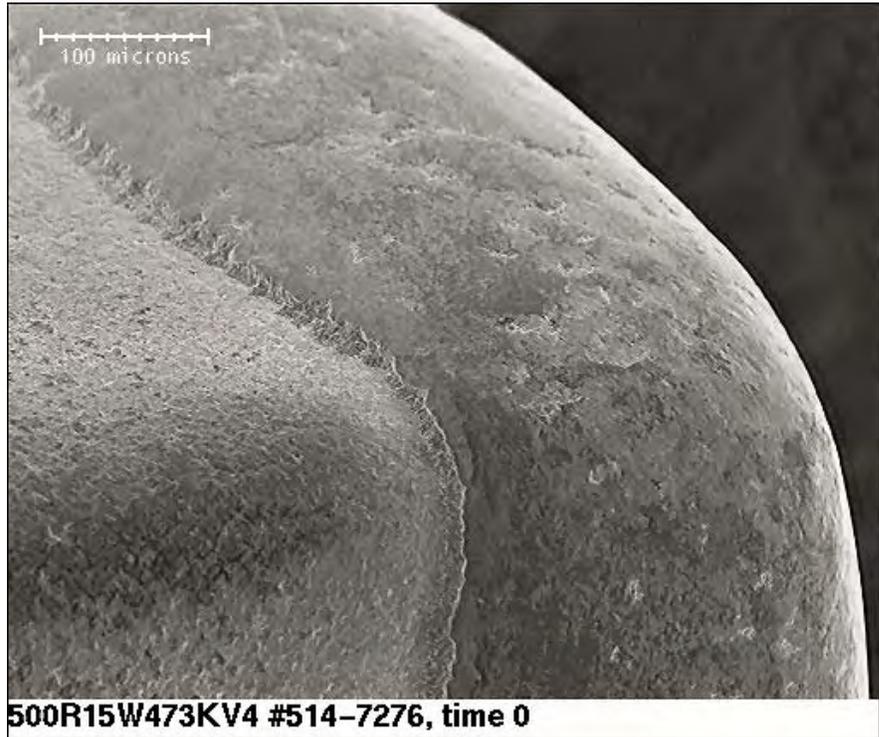


### 500R15W473KV4 – pre Temp Cycle

**Fig. 51**

**250x magnification**

**Sample 11 - right**



**Fig. 52**

**2500x magnification**

**Sample 11 - right**

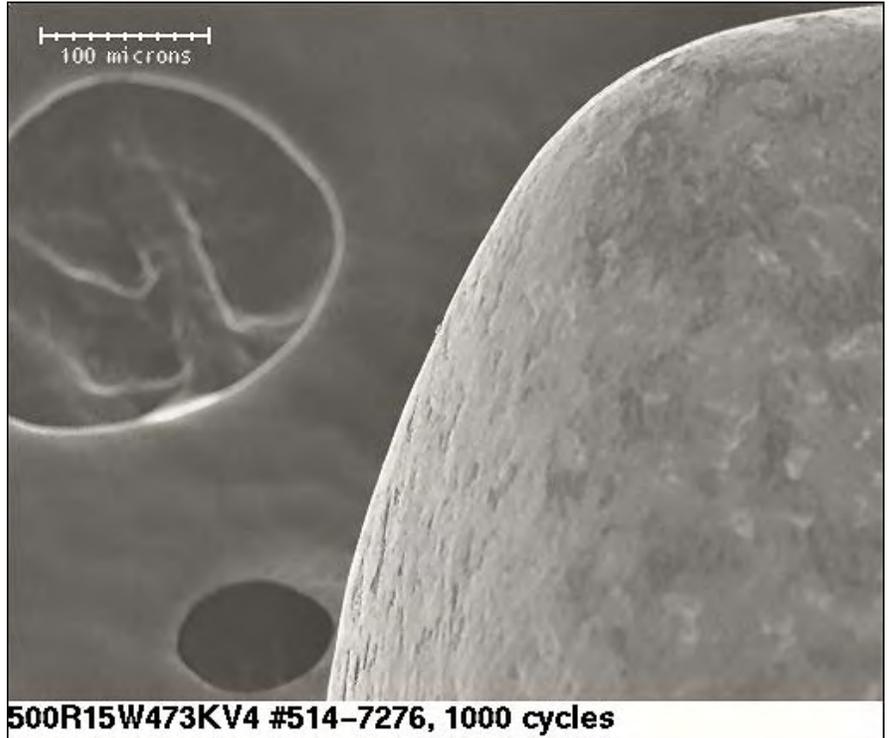


**500R15W473KV4 - 1000 cycles**

**Fig. 53**

**250x magnification**

**Sample 12 - left**



**Fig. 54**

**2500x magnification**

**Sample 12 - left**

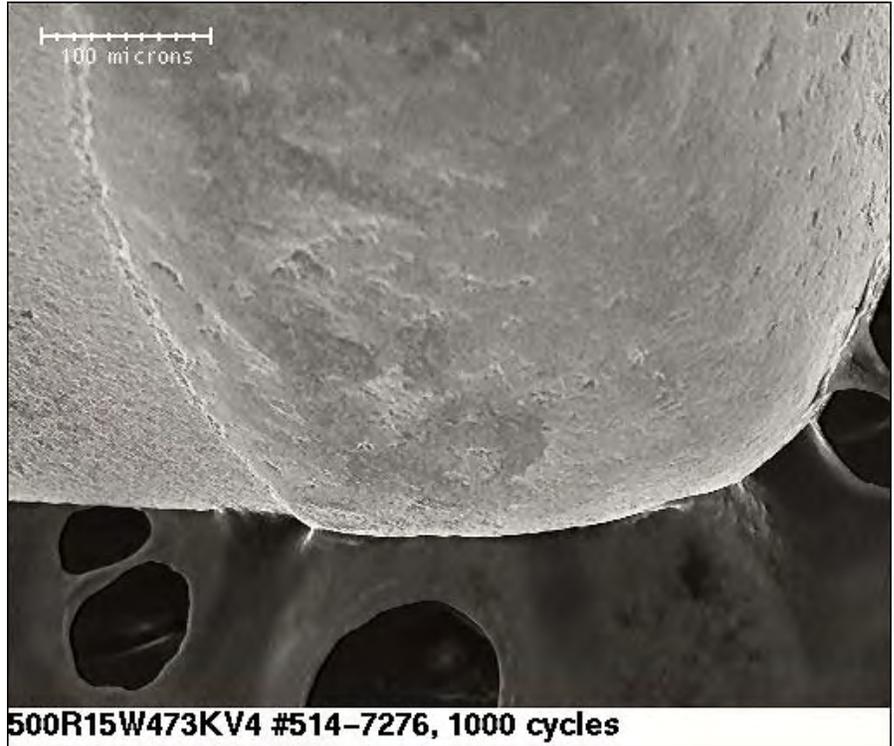


**500R15W473KV4 - 1000 cycles**

**Fig. 55**

**250x magnification**

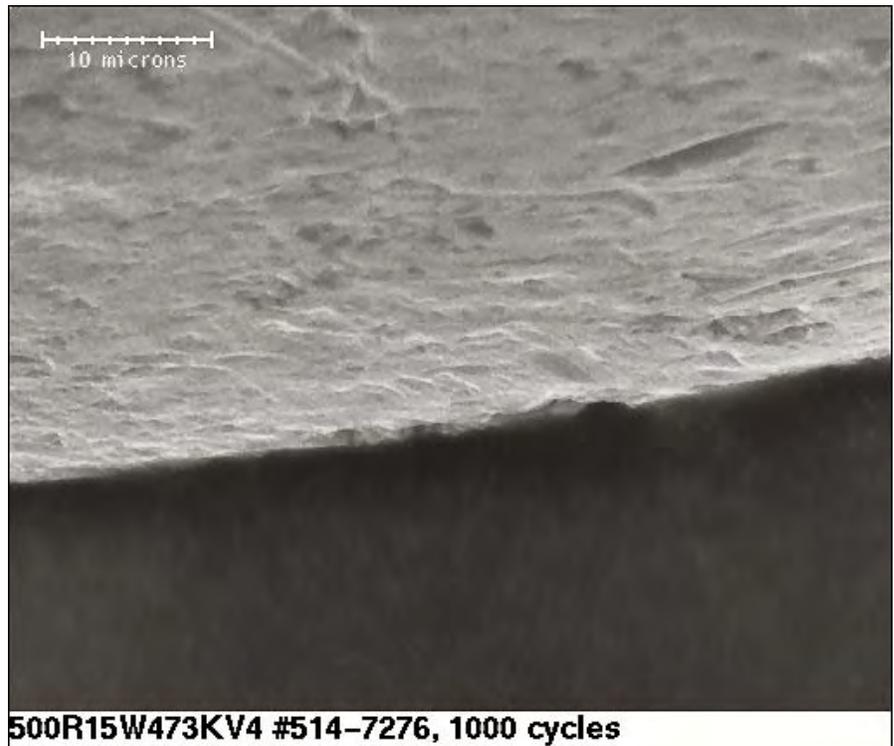
**Sample 12 - right**



**Fig. 56**

**2500x magnification**

**Sample 12 - right**



### 500R15W473KV4 – pre Temp Cycle

Fig. 57

250x magnification

Sample 13 - left



Fig. 58

2500x magnification

Sample 13 - left

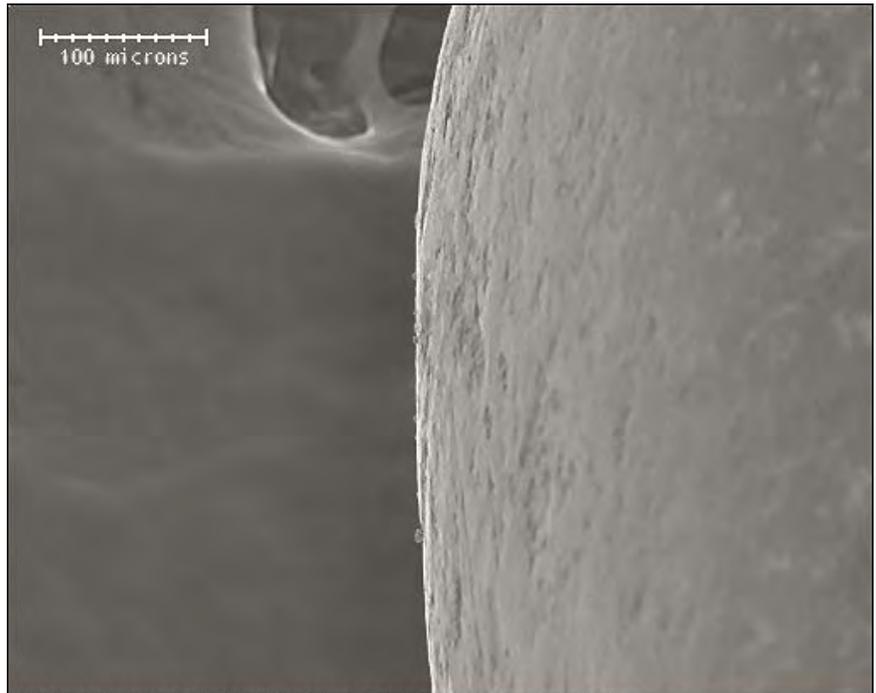


**500R15W473KV4 - 1000 cycles**

**Fig. 59**

**250x magnification**

**Sample 13 - left**



**500R15W473KV4 #514-7276, 1000 cycles**

**Fig. 60**

**2500x magnification**

**Sample 13 - left**



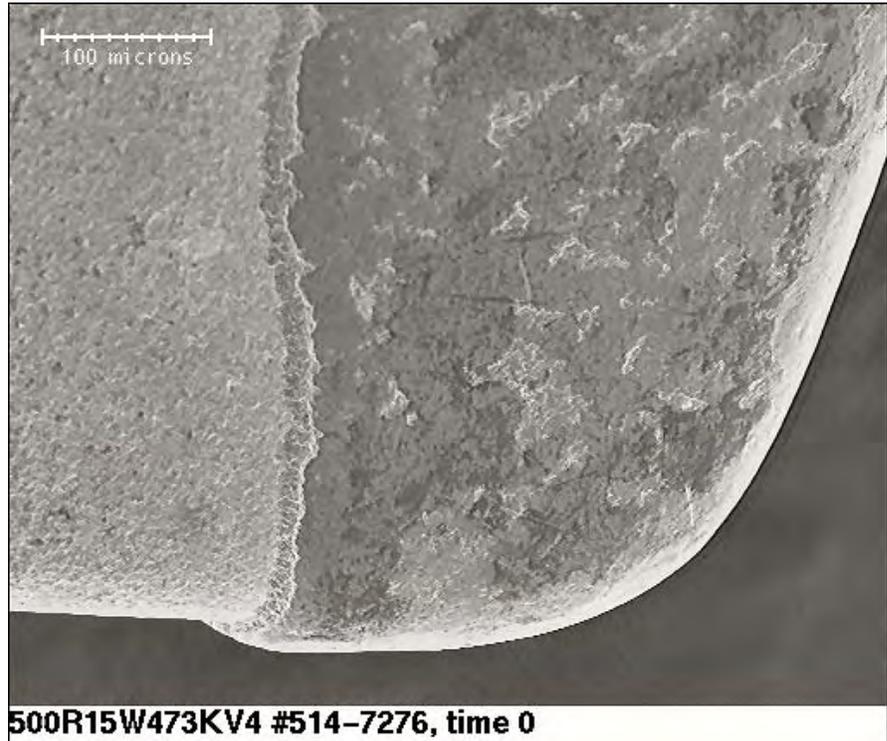
**500R15W473KV4 #514-7276, 1000 cycles**

### 500R15W473KV4 – pre Temp Cycle

**Fig. 61**

**250x magnification**

**Sample 13 - right**



**Fig. 62**

**2500x magnification**

**Sample 13 - right**

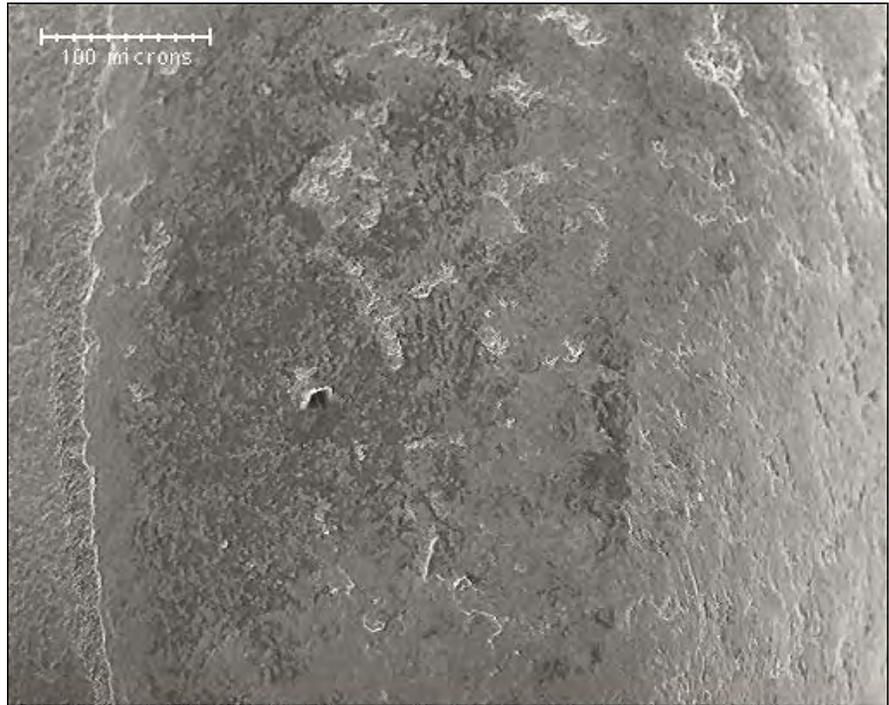


**500R15W473KV4 - 1000 cycles**

**Fig. 63**

**250x magnification**

**Sample 13 - right**

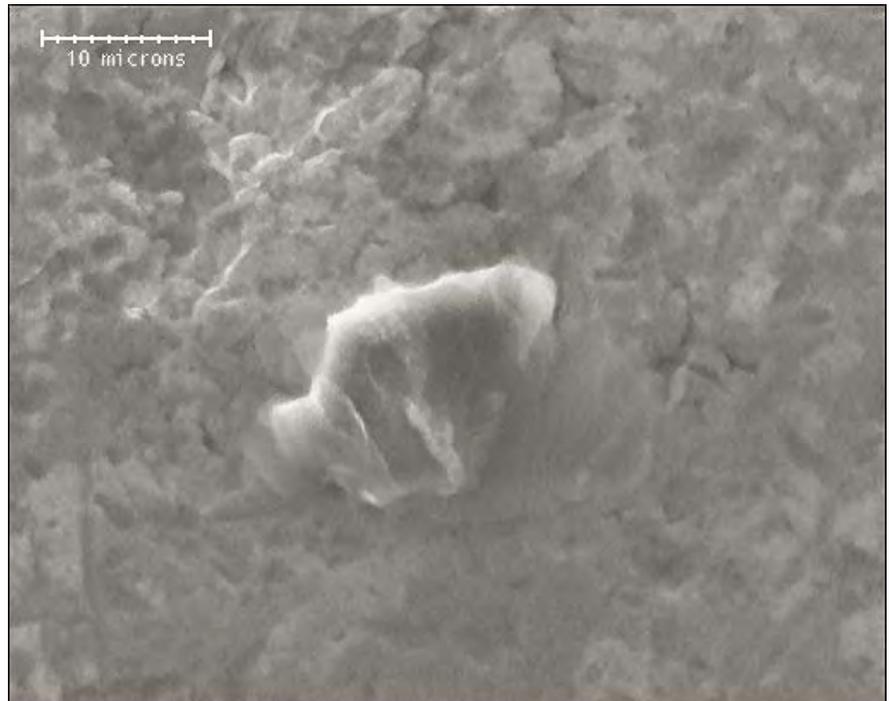


**500R15W473KV4 #514-7276, 1000 cycles**

**Fig. 64**

**2500x magnification**

**Sample 13 - right**



**500R15W473KV4 #514-7276, 1000 cycles**

### 500R15W473KV4 – pre Temp Cycle

**Fig. 65**

**250x magnification**

**Sample 15 - left**



**Fig. 66**

**2500x magnification**

**Sample 15 - left**

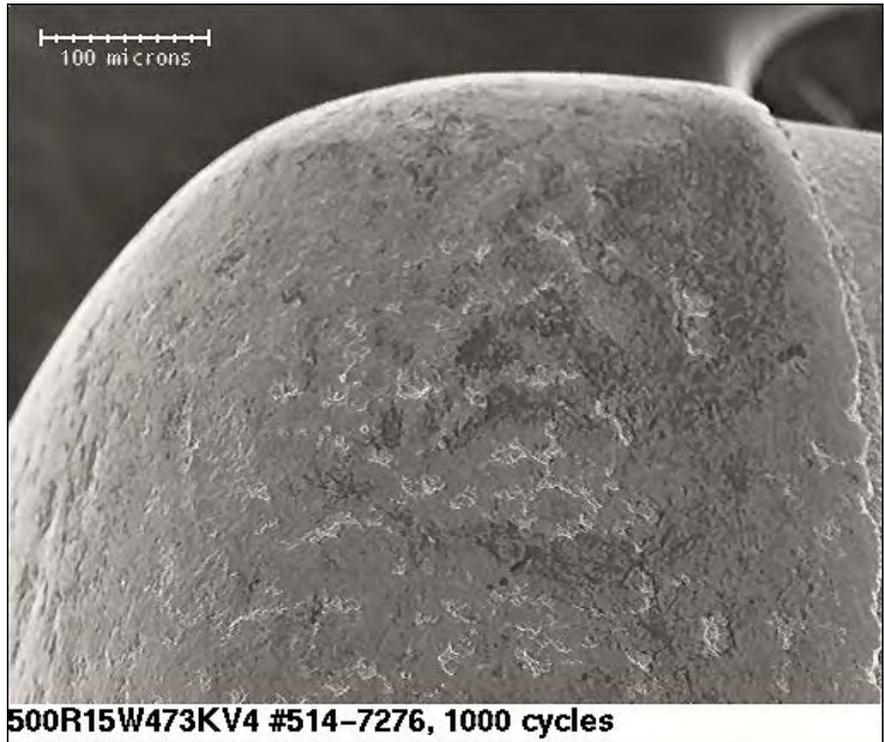


**500R15W473KV4 - 1000 cycles**

**Fig. 67**

**250x magnification**

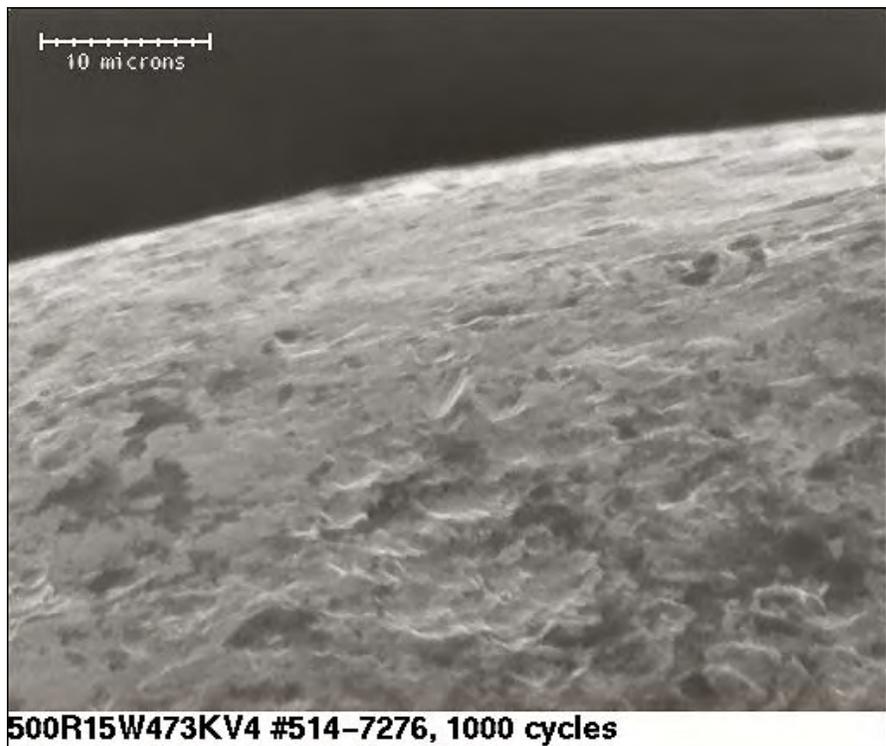
**Sample 15 - left**



**Fig. 68**

**2500x magnification**

**Sample 15 - left**

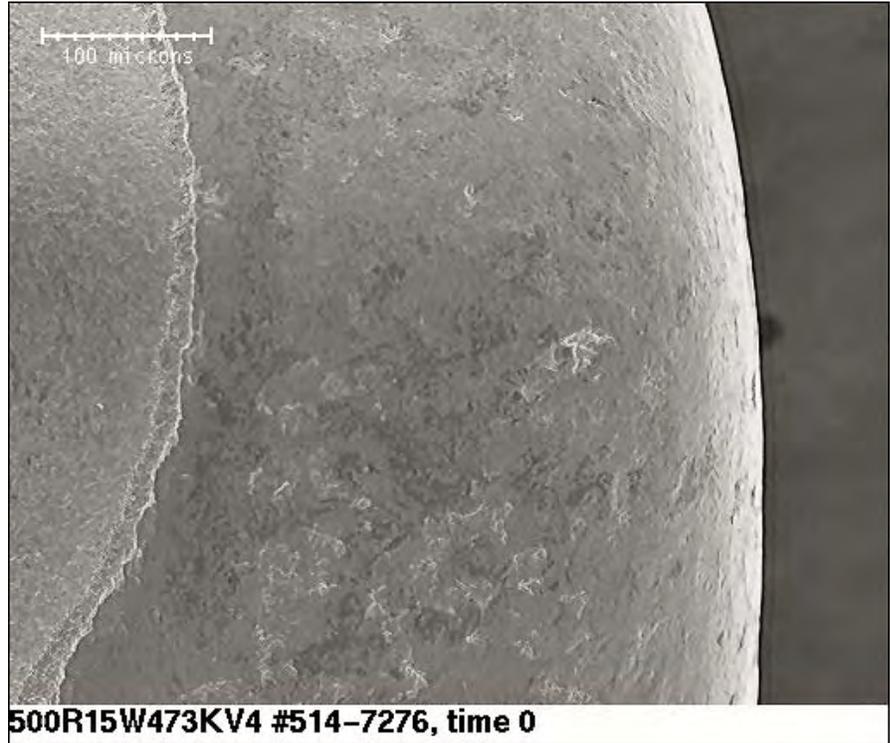


### 500R15W473KV4 – pre Temp Cycle

**Fig. 69**

**250x magnification**

**Sample 15 - right**



**Fig. 70**

**2500x magnification**

**Sample 15 - right**

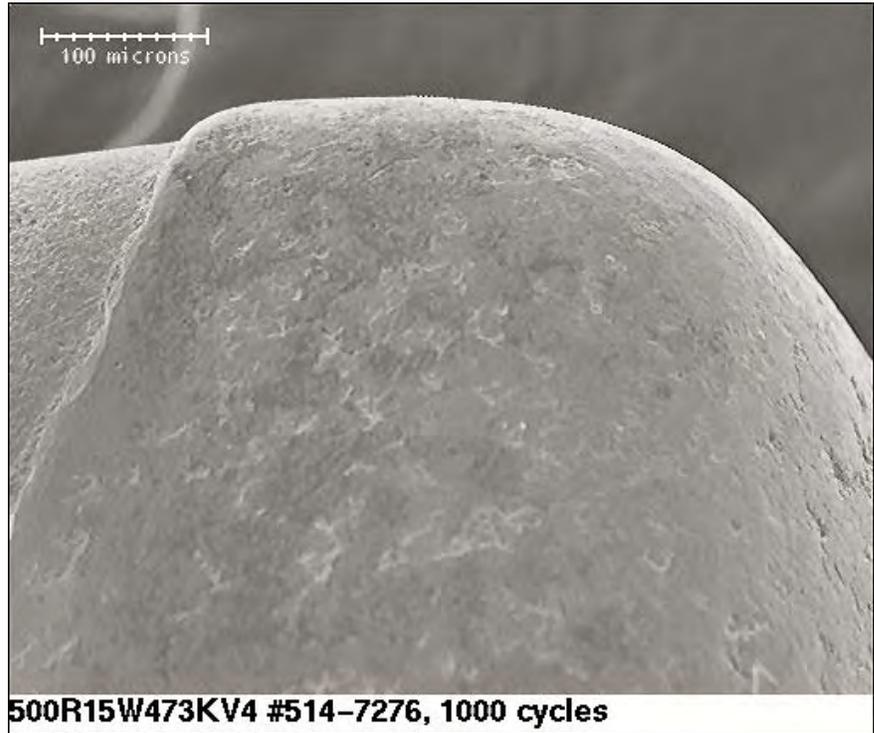


**500R15W473KV4 - 1000 cycles**

**Fig. 71**

**250x magnification**

**Sample 15 - right**



**Fig. 72**

**2500x magnification**

**Sample 15 - right**

