

## Appendix F1

### SEM/EDS Data for Test #4 Day-30 Aluminum Coupons

#### List of Figures

Figure F1-1: SEM image magnified 100 times for a Test #4 Day-30 unsubmerged aluminum coupon sample. (T4D30AlSusp001.bmp).....	F1-4
Figure F1-2: SEM image magnified 500 times for a Test #4 Day-30 unsubmerged aluminum coupon sample. (T4D30AlSusp002.bmp).....	F1-4
Figure F1-3: Annotated SEM image magnified 1000 times for a Test #4 Day-30 unsubmerged aluminum coupon sample. (T4D30AlSusp003.bmp) .....	F1-5
Figure F1-4: EDS counting spectrum for the deposits (EDS1) on the coupon surface shown in Figure F1-3. (T4D30AlSusp01.jpg).....	F1-5
Figure F1-5: EDS counting spectrum for the flat coupon surface (EDS2) shown in Figure F1-3. (T4D30AlSusp02.jpg) .....	F1-7
Figure F1-6: SEM image magnified 100 times for a Test #4 Day-30 submerged aluminum coupon sample. (T4D30AlSubm004.bmp) .....	F1-9
Figure F1-7: SEM image magnified 500 times for a Test #4 Day-30 submerged aluminum coupon sample. (T4D30AlSubm005.bmp) .....	F1-9
Figure F1-8: Annotated SEM image magnified 1000 times for a Test #4 Day-30 submerged aluminum coupon sample. (T4D30AlSubm006.bmp) .....	F1-10
Figure F1-9: EDS counting spectrum for the deposits (EDS3) on the coupon surface shown in Figure F1-8. (T4D30AlSubm03.jpg) .....	F1-10
Figure F1-10: EDS counting spectrum for the flat coupon surface (EDS4) shown in Figure F1-8. (T4D30AlSubm04.jpg).....	F1-12
Figure F1-11: SEM image magnified 5000 times for a Test #4 Day-30 submerged aluminum coupon sample. (T4D30AlSubm007.bmp) .....	F1-14

## **List of Tables**

Table F1-1. Chemical Compositions for T4D30AlSusp01.jpg, Figure F1-4 .....	F1-6
Table F1-2. Chemical Compositions for T4D30AlSusp02.jpg, Figure F1-5 .....	F1-8
Table F1-3. Chemical Compositions for T4D30AlSubm03.jpg, Figure F1-9.....	F1-11
Table F1-4. Chemical Compositions for T4D30Alsubm04.jpg, Figure F1-10 .....	F1-13

This page is intentionally blank.

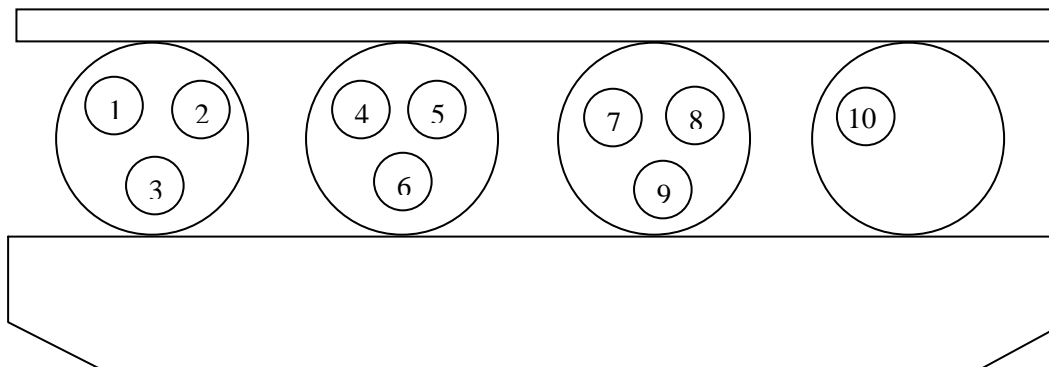
This appendix shows the SEM/EDS results for the metal aluminum coupons under two categories: (1) unsubmerged and (2) submerged. Unsubmerged refers to coupons held in the test tank gas space above the water level of the solution during ICET tests. Unsubmerged coupons were contacted by the solution only during the 4-hour spraying period at the initial date of the test. In addition, the surface of the unsubmerged coupons may also be affected by the moisture in the gas space during the test. Submerged refers to the coupons that were under the solution during the test.

The coupon samples were collected on June 23, 2005 (the date Test #4 was shut down) and examined by SEM/EDS on June 29, 2005. The aluminum coupon samples were dried in air before coating with Au/Pd for SEM examination. SEM results present the surface condition of the aluminum coupons. In addition, EDS results provide a semi-quantitative elemental analysis of the coupon surface and the corrosion products.

## Transcribed Laboratory Log

Laboratory session from June 29, 2005.  
SEM Test #4 Day-30 Aluminum Coupons.

- |                   |                         |                   |               |
|-------------------|-------------------------|-------------------|---------------|
| 1. Unsubmerged Al | 3. Sus. Cu              | 5. Sus. Gal-Steel | 7. Sus. Steel |
| 2. Submerged Al   | 4. Sub. Cu              | 6. Sub. Gal Steel | 8. Sub. Steel |
| 9. Sediment       | 10. Powder on sub. Rack |                   |               |

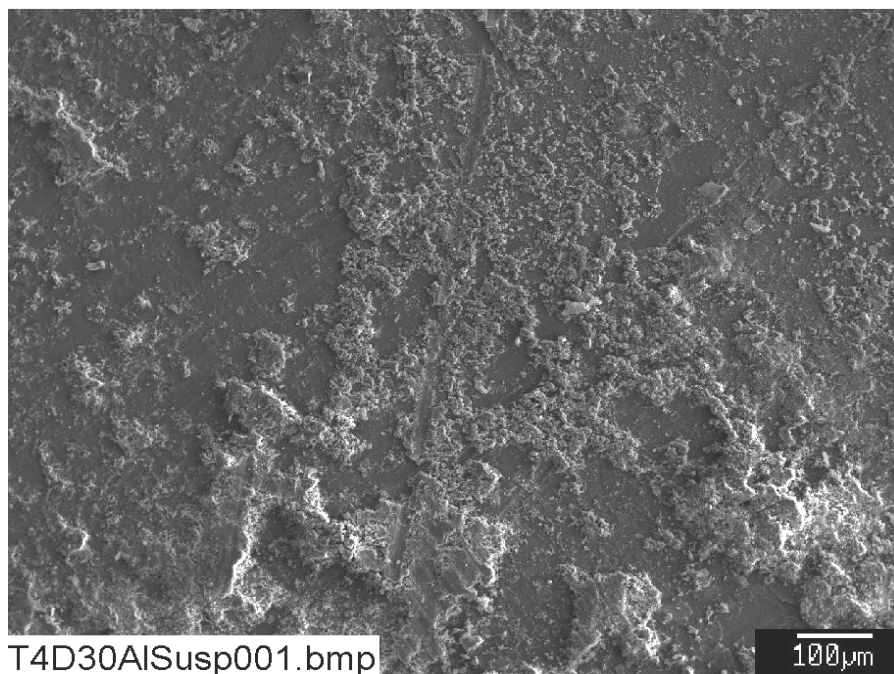


### Unsubmerged Aluminum Coupons.

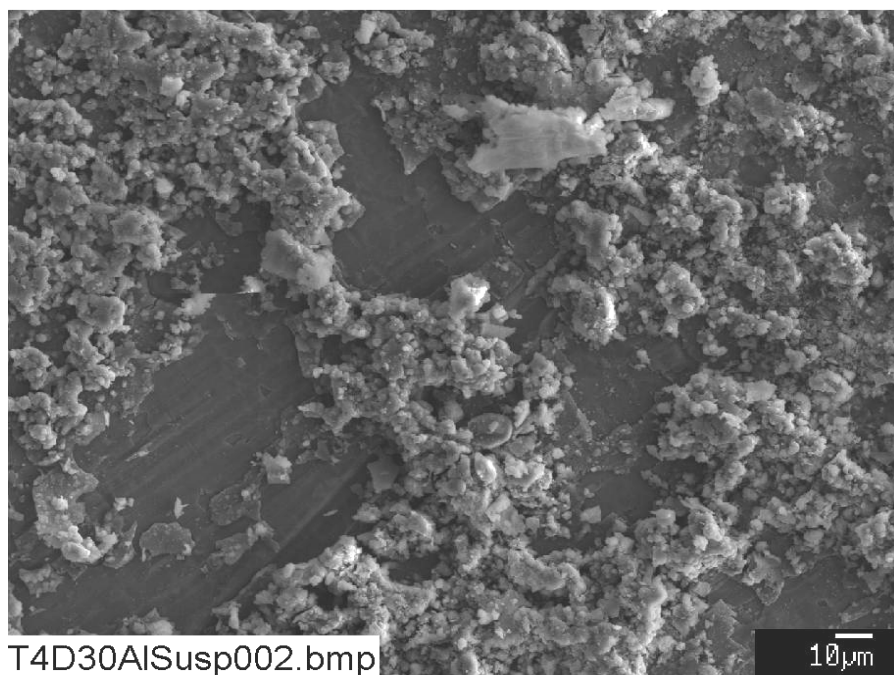
Image:	T4D30AlSusp001	100 ×	SEM image	Figure F1-1
	T4D30AlSusp002	500 ×	SEM image higher magnification	Figure F1-2
	T4D30AlSusp003	1000 ×	SEM annotated image	Figure F1-3
EDS:	T4D30AlSusp01		On particles at Al surface shown in image T4D30AlSusp003	Figure F1-4
	T4D30AlSusp02		On Al coupon surface shown in image T4D30AlSusp003	Figure F1-5

### Submerged Al Coupon.

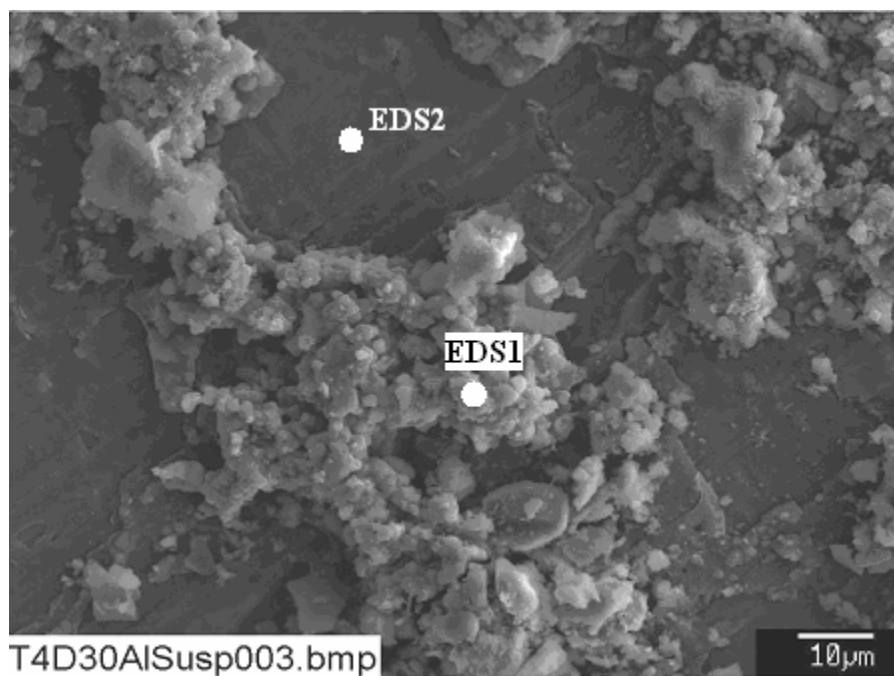
Image:	T4D30AlSubm004	100 ×	SEM image of fiberglass	Figure F1-6
	T4D30AlSubm005	500 ×	SEM image higher magnification	Figure F1-7
	T4D30AlSubm006	1000 ×	SEM annotated image	Figure F1-8
EDS:	T4D30AlSubm03		EDS of particles shown in 006	Figure F1-9
	T4D30Alsubm04		EDS of Al surface in 006	Figure F1-10
Image:	T4D30AlSubm007	5000 ×	SEM image higher magnification	Figure F1-11



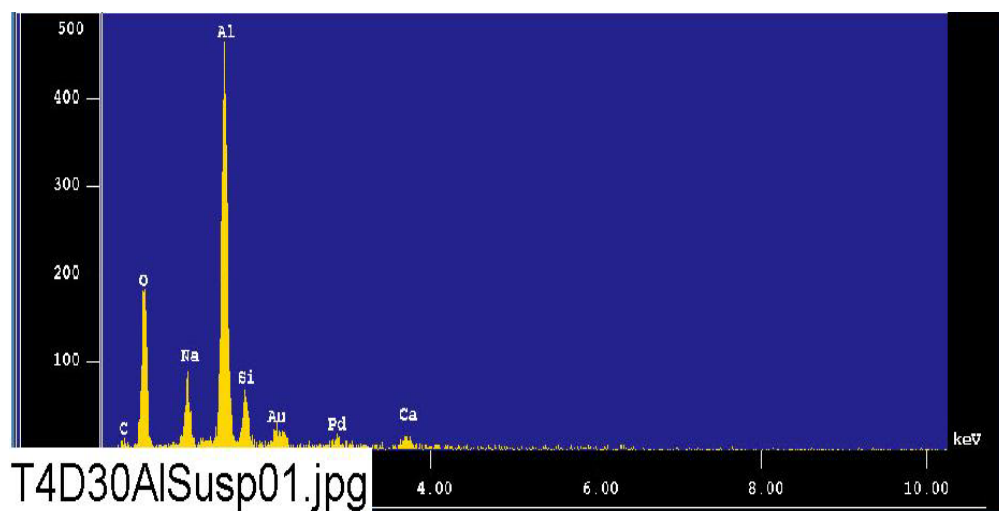
**Figure F1-1: SEM image magnified 100 times for a Test #4 Day-30 unsubmerged aluminum coupon sample. (T4D30AlSusp001.bmp)**



**Figure F1-2: SEM image magnified 500 times for a Test #4 Day-30 unsubmerged aluminum coupon sample. (T4D30AlSusp002.bmp)**



**Figure F1-3: Annotated SEM image magnified 1000 times for a Test #4 Day-30 unsubmerged aluminum coupon sample. (T4D30AlSusp003.bmp)**



**Figure F1-4: EDS counting spectrum for the deposits (EDS1) on the coupon surface shown in Figure F1-3. (T4D30AlSusp01.jpg)**

The results from the chemical composition analysis for T4D30AlSusp01.jpg are given in Table F1-1

**Table F1-1. Chemical Compositions for T4D30AlSusp01.jpg, Figure F1-4**

Jun 29 10:11 2005

Group : NRC  
Sample : T4D30 ID# : 1  
Comment : Particle on suspended Al  
Condition : Full Scale : 20KeV(10eV/ch,2Kch)  
Live Time : 60.000 sec Aperture # : 2  
Acc. Volt : 15.0 KV Probe Current : 1.069E-09 A  
Stage Point : X=86.836 Y=58.400 Z=10.786  
Acq. Date : Wed Jun 29 10:06:34 2005

Element	Mode	ROI (KeV)	K-ratio(%)	+/-	Net/Background
O K	Normal	0.25- 0.77	49.7713	0.0017	1653 / 8
Na K	Normal	0.81- 1.27	6.5744	0.0007	627 / 6
Al K	Normal	1.26- 1.78	29.7835	0.0010	4103 / 29
Si K	Normal	1.50- 2.07	3.1103	0.0004	400 / 238
Ca K	Normal	3.40- 4.30	1.8580	0.0027	116 / 2
C K	Normal	0.09- 0.46	0.1137	0.0001	6 / 16

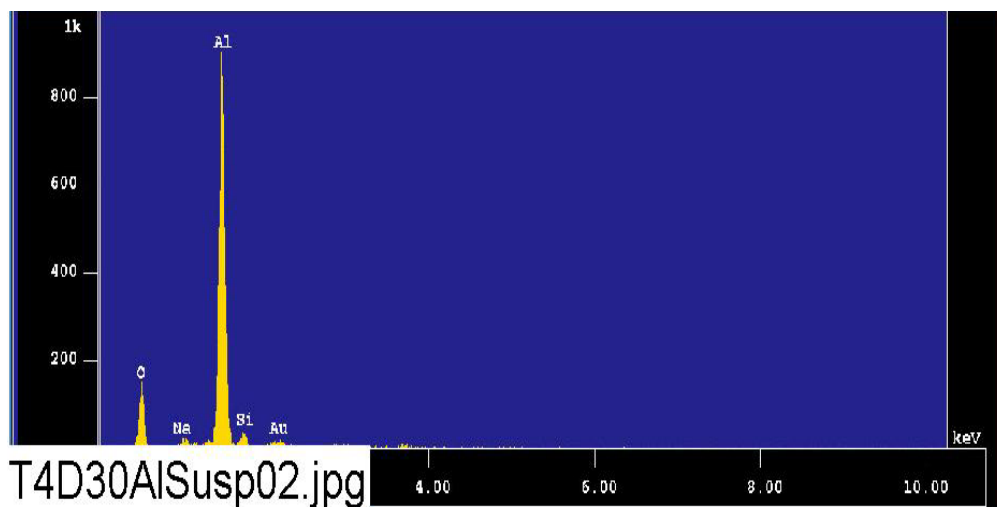
-----  
Chi\_square = 3.1919

Element	Mass%	Atomic%	ZAF	Z	A	F
O	47.921	60.0922	0.9108	0.9888	0.9212	0.9999
Na	8.495	7.4130	1.2222	1.0435	1.1736	0.9980
Al	35.757	26.5870	1.1356	1.0048	1.1313	0.9990
Si	5.079	3.6282	1.5447	0.9930	1.5557	1.0000
Ca	1.975	0.9887	1.0056	1.0019	1.0036	1.0001
C	0.773	1.2909	6.4296	1.0368	6.2020	1.0000

-----  
Total 100.000 100.0000

Normalization factor = 1.0572





**Figure F1-5: EDS counting spectrum for the flat coupon surface (EDS2) shown in Figure F1-3. (T4D30AlSusp02.jpg)**

The results from the chemical composition analysis for T4D30AlSusp02.jpg are given in Table F1-2.

Table F1-2. Chemical Compositions for T4D30AlSusp02.jpg, Figure F1-5

Jun 29 10:15 2005

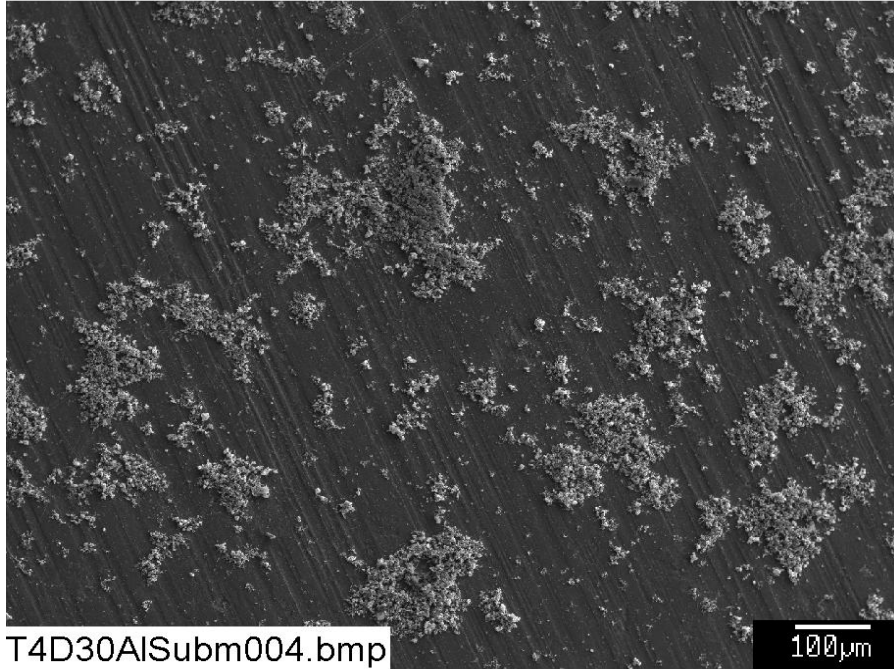
Group : NRC  
Sample : T4D30 ID# : 2  
Comment : Surface of suspended Al  
Condition : Full Scale : 20KeV(10eV/ch,2Kch)  
Live Time : 60.000 sec Aperture # : 2  
Acc. Volt : 15.0 KV Probe Current : 1.068E-09 A  
Stage Point : X=86.836 Y=58.400 Z=10.786  
Acq. Date : Wed Jun 29 10:13:59 2005

Element	Mode	ROI (KeV)	K-ratio(%)	+/-	Net/Background
O K	Normal	0.25- 0.77	36.6938	0.0015	1217 / 4
Na K	Normal	0.81- 1.27	1.3775	0.0004	131 / 8
Al K	Normal	1.26- 1.78	57.7086	0.0014	7943 / 24
Si K	Normal	1.50- 2.07	1.7543	0.0003	225 / 430

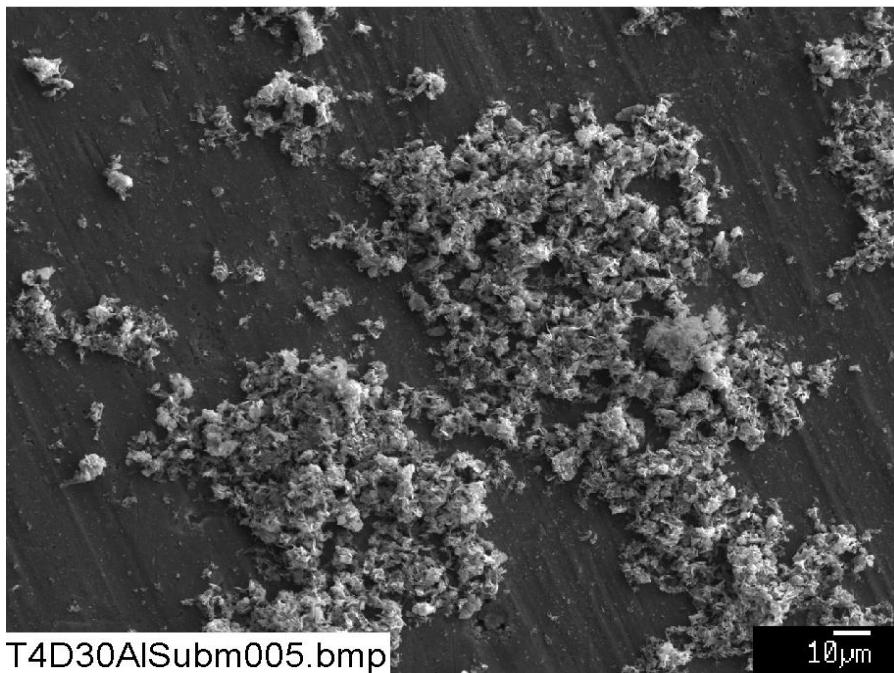
Chi\_square = 4.6847

Element	Mass%	Atomic%	ZAF	Z	A	F
O	36.111	48.7449	0.9776	0.9856	0.9919	0.9999
Na	1.540	1.4468	1.1106	1.0400	1.0727	0.9956
Al	59.291	47.4571	1.0206	1.0013	1.0198	0.9995
Si	3.058	2.3512	1.7314	0.9893	1.7500	1.0000

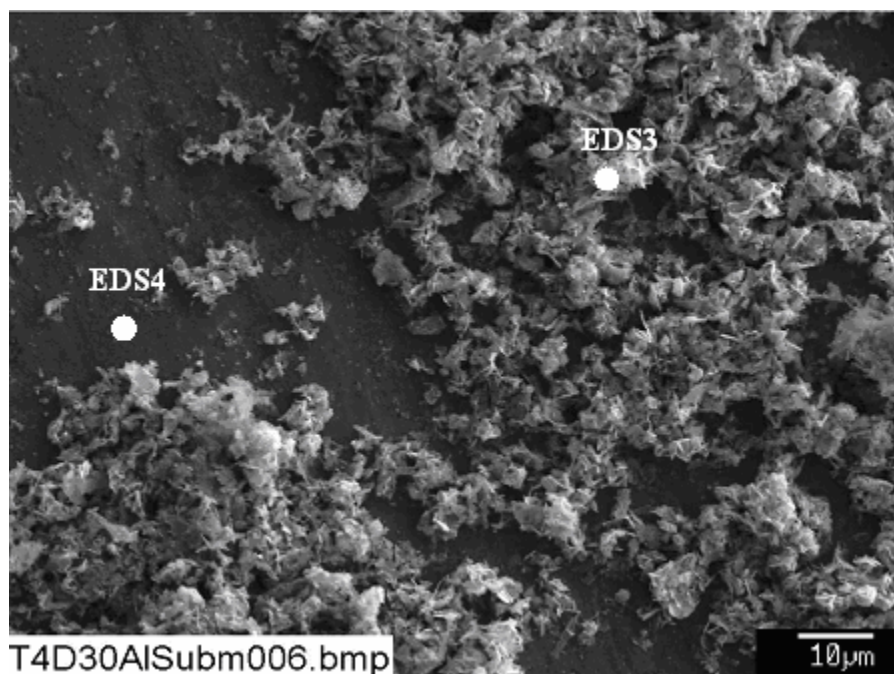
Total 100.000 100.0000  
Normalization factor = 1.0067



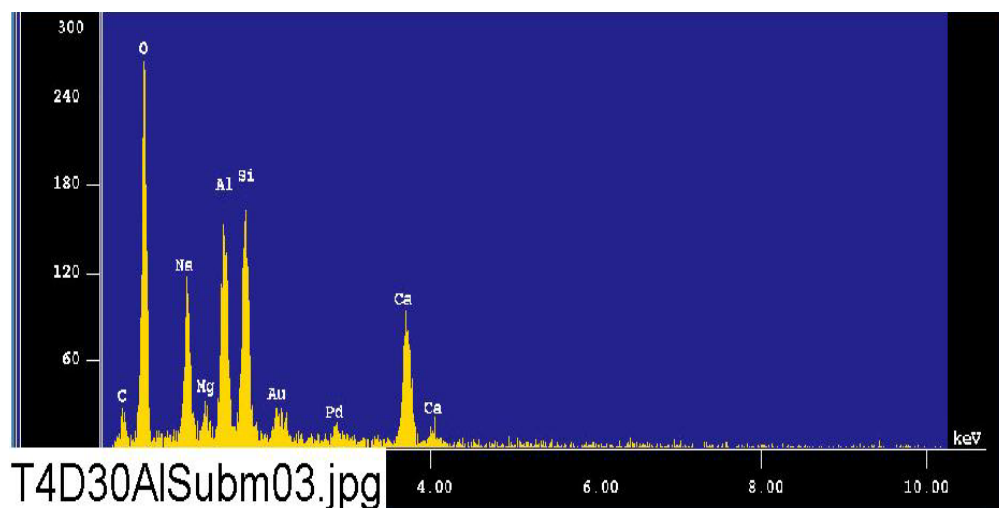
**Figure F1-6: SEM image magnified 100 times for a Test #4 Day-30 submerged aluminum coupon sample. (T4D30AlSubm004.bmp)**



**Figure F1-7: SEM image magnified 500 times for a Test #4 Day-30 submerged aluminum coupon sample. (T4D30AlSubm005.bmp)**



**Figure F1-8: Annotated SEM image magnified 1000 times for a Test #4 Day-30 submerged aluminum coupon sample. (T4D30AlSubm006.bmp)**



**Figure F1-9: EDS counting spectrum for the deposits (EDS3) on the coupon surface shown in Figure F1-8. (T4D30AlSubm03.jpg)**

The results from the chemical composition analysis for T4D30AlSubm03.jpg are given in Table F1-3.

Table F1-3. Chemical Compositions for T4D30AlSubm03.jpg, Figure F1-9

Jun 29 10:32 2005 /tmp/eds\_pout.log Page 1

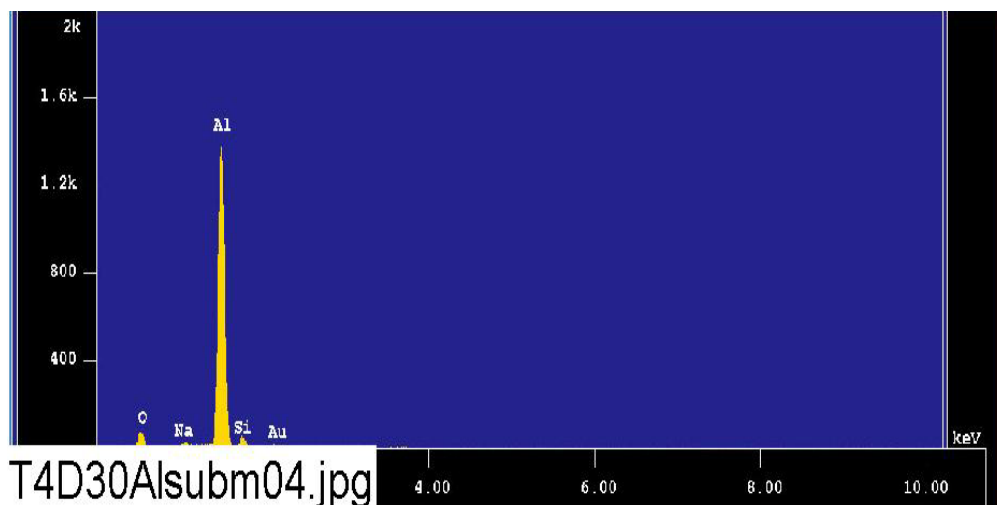
Group : NRC  
Sample : T4D30 ID# : 3  
Comment : Particles on submerged Al  
Condition : Full Scale : 20KeV(10eV/ch,2Kch)  
Live Time : 60.000 sec Aperture # : 2  
Acc. Volt : 15.0 KV Probe Current : 1.067E-09 A  
Stage Point : X=74.706 Y=62.388 Z=10.786  
Acq. Date : Wed Jun 29 10:30:29 2005

Element	Mode	ROI (KeV)	K-ratio(%)	+/-	Net/Background	
C K	Normal	0.09- 0.46	0.5999	0.0002	29 /	15
O K	Normal	0.25- 0.77	68.4438	0.0020	2268 /	16
Na K	Normal	0.81- 1.27	9.1569	0.0008	872 /	18
Mg K	Normal	0.97- 1.57	1.2076	0.0002	167 /	24
Al K	Normal	1.26- 1.78	9.9577	0.0007	1369 /	79
Si K	Normal	1.50- 2.07	8.1480	0.0007	1045 /	80
Ca K	Normal	3.40- 4.30	13.3080	0.0052	829 /	4

Chi\_square = 3.4940

Element	Mass%	Atomic%	ZAF	Z	A	F
C	2.021	3.2391	4.2355	1.0372	4.0840	0.9999
O	57.541	69.2225	1.0567	0.9892	1.0682	1.0000
Na	10.097	8.4534	1.3860	1.0441	1.3282	0.9994
Mg	1.535	1.2155	1.5981	0.9830	1.6294	0.9978
Al	9.810	6.9977	1.2382	1.0055	1.2340	0.9980
Si	8.534	5.8480	1.3164	0.9937	1.3251	0.9998
Ca	10.462	5.0238	0.9881	1.0029	0.9851	1.0001

Total 100.000 100.0000  
Normalization factor = 0.7956



**Figure F1-10: EDS counting spectrum for the flat coupon surface (EDS4) shown in Figure F1-8. (T4D30AlSubm04.jpg)**

The results from the chemical composition analysis for T4D30Alsubm04.jpg are given in Table F1-4.

**Table F1-4. Chemical Compositions for T4D30Alsubm04.jpg, Figure F1-10**

Jun 29 10:46 2005 /tmp/eds\_pout.log Page 1

```

Group       : NRC
Sample      : T4D30 ID# : 4
Comment     : Surface of submerged Al
Condition   : Full Scale : 20KeV(10eV/ch,2Kch)
              Live Time  : 60.000 sec   Aperture #   : 2
              Acc. Volt  : 15.0 KV      Probe Current : 1.068E-09 A
              Stage Point : X=74.653 Y=62.211 Z=10.786
              Acq. Date  : Wed Jun 29 10:41:51 2005

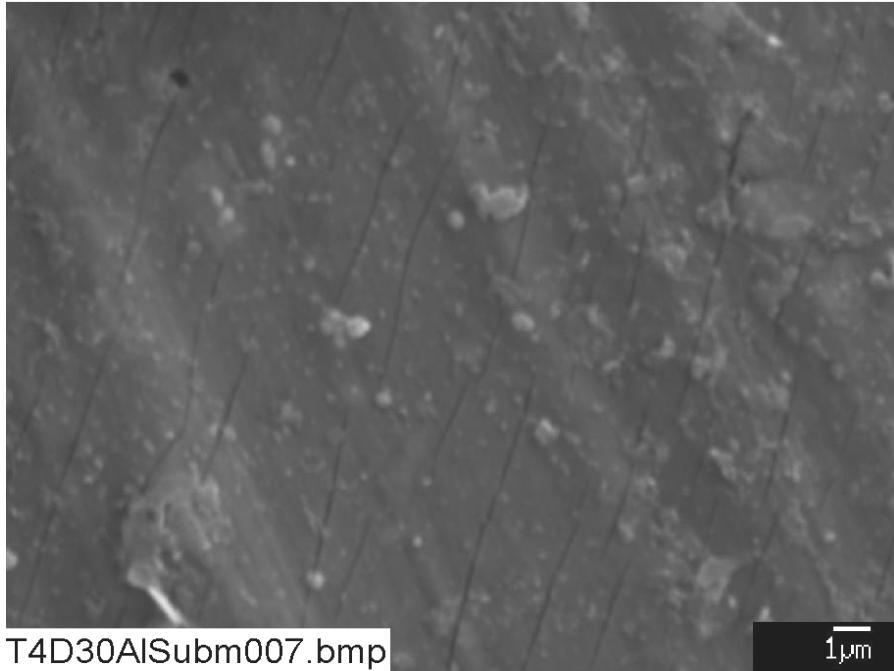
```

Element	Mode	ROI(KeV)	K-ratio(%)	+/-	Net/Background
O K	Normal	0.25- 0.77	23.8625	0.0013	792 / 7
Na K	Normal	0.81- 1.27	1.5073	0.0005	144 / 13
Al K	Normal	1.26- 1.78	98.1067	0.0019	13504 / 30
Si K	Normal	1.50- 2.07	2.4247	0.0004	311 / 724

Chi\_square = 2.7984

Element	Mass%	Atomic%	ZAF	Z	A	F
O	20.718	30.5721	1.1041	0.9815	1.1250	0.9999
Na	1.176	1.2077	0.9922	1.0354	0.9648	0.9933
Al	74.561	65.2404	0.9665	0.9967	0.9702	0.9995
Si	3.545	2.9798	1.8592	0.9847	1.8881	1.0000

Total 100.000 100.0000  
Normalization factor = 0.7863



**Figure F1-11: SEM image magnified 5000 times for a Test #4 Day-30 submerged aluminum coupon sample. (T4D30AlSubm007.bmp)**