



CHAPTER 8 REFERENCES

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LORD,

Thank you for being at my side and

holding my hand.

Sometimes the road seemed long,

but LORD,

You were always there

to give me strength and

guide me on my way.

ADDENDUM A

Fibroblasts counts X dilution factor X 10⁴

Seeding concentration was 10.58 X 10⁴ cells.ml⁻¹.

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Time Sample	Day 1				Day 2				Day 14				Day 28			
	Mic 1	Mic 2	Ave	%	Mic 1	Mic 2	Ave	%	Mic 1	Mic 2	Ave	%	Mic 1	Mic 2	Ave	%
Control	4.76	4.86	4.82	45.52	5.94	6.32	6.13	58.01	13.08	11.58	12.29	115.72	13.54	13.34	13.42	126.96
cpTi mach cont	3.26	4.76	4.01	37.81	6.22	6.66	6.44	60.91	9.42	10.75	10.80	95.36	13.40	14.40	13.90	131.38
cpTi mach SI	4.00	5.12	4.56	43.06	4.22	5.26	4.74	44.76	11.00	9.50	10.26	96.88	6.44	4.40	5.42	51.25
cpTi mach ES	2.00	3.66	2.84	26.78	3.14	3.42	3.28	31.06	16.40	13.60	15.00	141.78	13.60	11.80	12.70	120.04
Ti6Al4V mach cont	2.66	4.47	3.70	35.05	5.20	4.80	5.00	47.26	16.60	12.44	14.52	137.26	11.40	17.26	14.32	135.40
Ti6Al4V mach SI	4.44	4.00	4.22	39.91	3.56	5.50	4.52	42.80	11.50	12.60	12.06	113.89	7.78	3.76	5.76	54.48
Ti6Al4V mach ES	2.00	5.72	3.86	36.46	5.12	4.88	5.00	47.26	17.80	12.80	15.30	144.61	4.40	5.00	4.70	44.42
cpTi cast cont	6.00	6.40	6.20	58.60	3.72	3.76	3.74	35.28	9.78	12.00	10.88	102.92	2.88	5.00	3.94	37.28
cpTi cast SI																
cpTi cast ES	4.00	5.34	4.66	44.11	3.26	5.40	4.32	40.88	14.20	15.20	14.70	138.94	7.12	4.76	5.94	56.05
Ti6Al4V cast cont	3.12	4.86	3.98	37.66	4.50	6.58	5.54	52.32	19.20	20.20	19.70	186.20	7.76	6.50	7.12	67.34
Ti6Al4V cast SI	5.80	3.78	4.78	45.26	7.00	5.00	6.00	56.71	13.80	13.00	13.40	126.65	3.60	4.66	4.14	39.07
Ti6Al4V cast ES	4.00	2.86	3.42	32.41	5.60	4.58	5.08	48.07	17.20	16.80	17.00	160.68	10.00	10.26	10.12	95.70

ADDENDUM B

Osteoblasts counts X dilution factor X 10⁴

Seeding concentration was 11.0 X 10⁴ cells.ml⁻¹.

Time Sample	2 days				14 days				28 days			
	Mic 1	Mic 2	Ave	%	Mic 1	Mic 2	Ave	%	Mic 1	Mic 2	Ave	%
Control	11.2	13.7	12.5	113.8	22.8	18.4	20.6	187.7	2.9	3.1	3.0	27.3
cpTi mach cont	12.2	16.2	14.2	129.1	16.8	17.6	17.2	156.4	4.2	7.4	5.8	52.8
cpTi mach SI	10.7	13.2	12.0	108.5	12.0	12.8	12.4	112.7	14.2	11.0	12.6	114.6
cpTi mach ES	11.3	12.6	11.9	108.4	14.4	10.6	12.5	113.4	6.6	6.4	6.5	59.3
Ti6Al4V mach cont	10.9	11.8	11.3	103.1	21.6	10.0	15.8	143.6	3.3	2.0	2.7	24.2
Ti6Al4V mach SI	7.1	8.3	7.7	69.8	22.0	20.0	21.0	190.9	18.8	19.6	19.2	174.6
Ti6Al4V mach ES	8.3	11.3	9.8	89.0	19.2	13.4	16.3	148.2	3.6	5.1	4.3	39.5
cpTi cast cont	9.7	13.6	11.6	105.8	12.4	9.8	11.1	100.9	2.0	3.6	2.8	25.5
cpTi cast SI	8.8	12.5	10.7	96.8	34.4	19.2	26.8	243.6	5.3	5.1	5.2	47.5
cpTi cast ES	10.2	10.9	10.5	95.9	28.2	20.2	24.2	220.0	6.2	6.2	6.2	56.5
Ti6Al4V cast cont	7.3	8.7	8.0	7.7	18.0	11.8	14.9	135.4	25.8	18.2	22.0	200.0
Ti6Al4V cast SI	11.2	14.0	12.6	114.6	20.0	22.4	21.2	192.7	5.8	6.4	6.1	55.4
Ti6Al4V cast ES	8.8	6.0	7.4	67.3	21.8	18.4	20.1	182.7	18.6	14.4	16.5	150.0

ADDENDUM C

Area Analysis

Area Ra values of the different samples analysed - 20 μ m scan

Samples	I	II	III	IV	V	Aver
cpTi mach cont	0.076	0.19	0.146	0.176	0.113	0.1402
cpTi mach cont RFGDT	0.13	0.086	0.062	0.085	0.126	0.0978
Ti6Al4V mach cont	0.082	0.089	0.083	0.143	0.045	0.0884
Ti6Al4V mach cont RFGDT	0.12	0.107	0.17	0.162	0.16	0.1438
cpTi cast cont	0.422	0.685	0.541	0.531	0.419	0.5196
cpTi cast cont RFGDT	0.702	0.524	0.538	0.97	0.5	0.6468
Ti6Al4V cast cont	0.597	0.195	0.311	0.682	0.463	0.4496
Ti6Al4V cast cont RFGDT	0.454	0.366	0.268	0.555	0.417	0.412

Area Ra values of the different samples analysed - 5 μ m scan

Samples	I	II	III	IV	V	Aver
cpTi mach cont	0.051	0.045	0.041	0.112	0.049	0.0596
cpTi mach cont RFGDT	0.156	0.035	0.033	0.061	0.041	0.0652
Ti6Al4V mach cont	0.082	0.071	0.105	0.105	0.047	0.082
Ti6Al4V mach cont RFGDT	0.111	0.075	0.157	0.117	0.071	0.1062
cpTi cast cont	0.319	0.161	0.222	0.499	0.108	0.2618
cpTi cast cont RFGDT	0.427	0.123	0.213	0.432	0.159	0.2708
Ti6Al4V cast cont	0.185	0.089	0.32	0.351	0.333	0.2556
Ti6Al4V cast cont RFGDT	0.402	0.244	0.05	0.176	0.132	0.2008

Area RMS values of the different samples analysed -20 μ m scan

Samples	I	II	III	IV	V	Aver
cpTi mach cont	0.093	0.219	0.176	0.219	0.153	0.172
cpTi mach cont RFGDT	0.173	0.106	0.08	0.11	0.167	0.1272
Ti6Al4V mach cont	0.103	0.108	0.106	0.175	0.059	0.1102
Ti6Al4V mach cont RFGDT	0.15	0.136	0.218	0.195	0.209	0.1816
cpTi cast cont	0.562	0.835	0.673	0.676	0.522	0.6536
cpTi cast cont RFGDT	0.877	0.609	0.682	1.14	0.651	0.7918
Ti6Al4V cast cont	0.736	0.227	0.393	0.832	0.584	0.5544
Ti6Al4V cast cont RFGDT	0.578	0.467	0.329	0.711	0.525	0.522

Area RMS values of the different samples analysed - 5 μ m scan

Samples	I	II	III	IV	V	Aver
cpTi mach cont	0.076	0.057	0.061	0.112	0.063	0.0738
cpTi mach cont RFGDT	0.2	0.051	0.04	0.077	0.05	0.0836
Ti6Al4V mach cont	0.098	0.087	0.122	0.144	0.056	0.1014
Ti6Al4V mach cont RFGDT	0.146	0.097	0.178	0.138	0.089	0.1296
cpTi cast cont	0.402	0.214	0.272	0.58	0.14	0.3216
cpTi cast cont RFGDT	0.512	0.173	0.267	0.497	0.233	0.3364
Ti6Al4V cast cont	0.238	0.104	0.381	0.441	0.405	0.3138
Ti6Al4V cast cont RFGDT	0.497	0.297	0.062	0.212	0.166	0.2468

Surface Area values of the different samples analysed – projected area of 400 μ m² scan

Samples	I	II	III	IV	V	Aver
cpTi mach cont	412.7	413.8	418.1	422.5	413.8	416.18
cpTi mach cont RFGDT	425.5	412.8	410.6	417.8	415	416.34
Ti6Al4V mach cont	415.8	417.2	415.9	416.7	409.4	415
Ti6Al4V mach cont RFGDT	426.9	420.2	417.2	433.8	427	425.02
cpTi cast cont	532	568.7	534.1	523.2	501.6	531.92
cpTi cast cont RFGDT	573.2	499.1	602.7	627.9	492.8	559.14
Ti6Al4V cast cont	570.3	434.3	472.1	547.6	517	508.26
Ti6Al4V cast cont RFGDT	585.7	559.9	424.8	579	526.9	535.26

Surface Area values of the different samples analysed – projected area of 25 μ m² scan

Samples	I	II	III	IV	V	Aver
cpTi mach cont	27.51	26.66	26.72	28.24	2.64	27.15
cpTi mach cont RFGDT	28.29	26.01	25.8	26.58	26.13	26.56
Ti6Al4V mach cont	27.26	27.0	27.9	28.79	25.6	27.31
Ti6Al4V mach cont RFGDT	28.6	27.2	27.0	29.3	21.8	28.04
cpTi cast cont	36.87	30.87	31.17	35.94	29.43	32.86
cpTi cast cont RFGDT	40.66	29.42	33.83	36.42	31.01	34.2
Ti6Al4V cast cont	31.88	28.26	36.76	41.35	36.47	34.94
Ti6Al4V cast cont RFGDT	39.3	37.71	25.75	29.74	29.45	32.39

Maximum range values of the different samples analysed - 20 μ m scan

Samples	I	II	III	IV	V	Aver
cpTi mach cont	0.812	0.963	1.022	1.19	1.22	1.0414
cpTi mach cont RFGDT	1.24	1.017	0.47	0.897	1.136	0.952
Ti6Al4V mach cont	0.817	0.949	0.752	1.518	0.602	0.9276
Ti6Al4V mach cont RFGDT	1.001	1.237	1.137	1.319	1.341	1.207
cpTi cast cont	4.046	4.607	3.918	4.201	2.93	3.9404
cpTi cast cont RFGDT	5.856	2.826	4.702	5.448	3.951	4.5566
Ti6Al4V cast cont	4.525	1.152	2.737	4.261	3.83	3.301
Ti6Al4V cast cont RFGDT	3.838	3.509	2.063	4.483	4.477	3.674

Maximum range values of the different samples analysed - 5 μ m scan

Samples	I	II	III	IV	V	Aver
cpTi mach cont	0.699	0.333	0.512	0.647	0.359	0.51
cpTi mach cont RFGDT	0.917	0.351	0.199	0.423	0.25	0.428
Ti6Al4V mach cont	0.46	0.463	0.528	0.942	0.242	0.527
Ti6Al4V mach cont RFGDT	0.972	0.591	0.632	0.616	0.571	0.6764
cpTi cast cont	1.843	1.152	1.466	2.47	1.14	1.6142
cpTi cast cont RFGDT	2.516	1.138	1.666	2.108	1.489	1.7834
Ti6Al4V cast cont	1.487	0.51	1.693	2.446	2.124	1.652
Ti6Al4V cast cont RFGDT	2.347	1.846	0.314	1.097	0.972	1.3152

Average height values of the different samples analysed - 20 μ m scan

Samples	I	II	III	IV	V	Aver
cpTi mach cont	0.535	0.633	0.614	0.779	0.363	0.5848
cpTi mach cont RFGDT	0.83	0.348	0.241	0.36	0.416	0.439
Ti6Al4V mach cont	0.509	0.569	0.485	1.151	0.459	0.6346
Ti6Al4V mach cont RFGDT	0.499	0.627	0.437	0.519	0.579	0.5322
cpTi cast cont	1.948	2.185	1.821	2.415	1.042	1.8822
cpTi cast cont RFGDT	3.463	1.245	2.311	2.926	1.102	2.2094
Ti6Al4V cast cont	2.583	0.509	1.274	1.99	2.35	1.7412
Ti6Al4V cast cont RFGDT	1.583	1.639	0.905	2.921	2.562	1.922

Average height values of the different samples analysed - 5 μ m scan

Samples	I	II	III	IV	V	Aver
cpTi mach cont	0.455	0.195	0.126	0.365	0.187	0.2656
cpTi mach cont RFGDT	0.421	0.244	0.108	0.204	0.114	0.2182
Ti6Al4V mach cont	0.271	0.312	0.281	0.763	0.106	0.3466
Ti6Al4V mach cont RFGDT	0.361	0.258	0.359	0.232	0.355	0.313
cpTi cast cont	0.83	0.429	0.587	1.184	0.377	0.6814
cpTi cast cont RFGDT	1.495	0.451	0.842	0.91	0.326	0.8048
Ti6Al4V cast cont	0.626	0.192	0.724	1.055	1.164	0.7522
Ti6Al4V cast cont RFGDT	0.898	0.811	0.144	0.501	0.572	0.5852

ADDENDUM D

Line Analysis - 20 μ m scans

Ra values of 20 μ m scan line analysis

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	V	Aver
cpTi mach cont	0.04	0.06	0.06	0.18	0.18	0.20	0.16	0.09	0.12	0.20	0.11	0.10	0.8	0.09	0.13	0.12
cpTi mach cont RFGDT	0.1	0.10	0.09	0.07	0.07	0.06	0.07	0.04	0.05	0.13	0.05	0.09	0.15	0.12	0.08	0.08
Ti6Al4V mach cont	0.09	0.07	0.06	0.09	0.08	0.09	0.10	0.69	0.05	0.14	0.13	0.12	0.05	0.03	0.03	0.08
Ti6Al4V mach cont RFGDT	0.16	0.10	0.10	0.08	0.07	0.11	0.03	0.10	0.21	0.18	0.13	0.12	0.13	0.14	0.14	0.12
cpTi cast cont	0.54	0.30	0.17	0.22	0.52	0.48	0.53	0.52	0.32	0.26	0.69	0.56	0.28	0.16	0.50	0.40
cpTi cast cont RFGDT	0.53	0.71	0.78	0.51	0.60	0.46	0.33	0.66	0.42	0.62	0.79	1.16	0.68	0.42	0.20	0.59
Ti6Al4V cast cont	0.52	0.50	0.57	0.17	0.18	0.20	0.22	0.16	0.33	0.42	0.58	0.82	0.29	0.43	0.43	0.39
Ti6Al4V cast cont RFGDT	0.32	0.44	0.46	0.28	0.40	0.39	0.19	0.08	0.30	0.52	0.26	0.51	0.39	0.30	0.24	0.34

Rp values of 20 μ m scan line analysis

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	V	Aver
cpTi mach cont	0.14	0.13	0.18	0.24	0.24	0.29	0.29	0.16	0.24	0.37	0.20	0.28	2.36	0.28	0.47	0.25
cpTi mach cont RFGDT	0.19	0.23	0.30	0.17	0.19	0.16	0.18	0.17	0.13	0.52	0.13	0.18	0.30	0.44	0.30	0.24
Ti6Al4V mach cont	0.18	0.17	0.20	0.25	0.16	0.20	0.26	0.13	0.12	0.28	0.25	0.22	0.09	0.08	0.09	0.18
Ti6Al4V mach cont RFGDT	0.39	0.26	0.23	0.18	0.27	0.42	0.08	0.18	0.35	0.32	0.39	0.32	0.38	0.29	0.55	0.31
cpTi cast cont	1.30	1.16	0.44	0.87	1.06	0.88	1.18	0.86	0.79	1.01	1.53	1.06	0.61	0.38	1.55	0.98
cpTi cast cont RFGDT	1.10	1.17	1.63	1.34	1.36	1.23	0.090	1.06	1.29	1.32	1.94	2.67	1.74	1.93	0.75	1.47
Ti6Al4V cast cont	1.08	0.96	0.94	0.33	0.36	0.42	0.39	0.26	0.83	0.78	1.21	2.18	0.64	1.23	0.82	0.83
Ti6Al4V cast cont RFGDT	1.04	1.15	2.08	0.91	1.46	1.03	0.34	0.32	0.95	1.10	0.71	1.08	1.19	0.68	0.60	0.98

Rpm values of 20 μm scan line analysis

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	V	Aver
cpTi mach cont	0.07	0.07	0.08	0.11	0.13	0.14	0.11	0.08	0.06	0.24	0.13	0.12	0.09	0.09	0.12	0.11
cpTi mach cont RFGDT	0.12	0.16	0.16	0.08	0.09	0.11	0.08	0.07	0.08	0.16	0.07	0.11	0.17	0.13	0.11	0.11
Ti6Al4V mach cont	0.12	0.10	0.09	0.11	0.08	0.10	0.09	0.09	0.05	0.09	0.10	0.11	0.06	0.03	0.04	0.08
Ti6Al4V mach cont RFGDT	0.24	0.14	0.12	0.10	0.16	0.12	0.02	0.07	0.13	0.23	0.25	0.17	0.16	0.13	0.16	0.15
cpTi cast cont	0.75	0.60	0.28	0.33	0.78	0.50	0.54	0.58	0.37	0.45	0.67	0.58	0.31	0.18	0.64	0.50
cpTi cast cont RFGDT	0.53	0.72	0.72	0.64	0.43	0.50	0.46	0.62	0.58	0.73	0.98	1.19	0.59	0.54	0.25	0.63
Ti6Al4V cast cont	0.63	0.58	0.66	0.16	0.17	0.20	0.17	0.17	0.43	0.28	0.56	0.69	0.38	0.55	0.43	0.40
Ti6Al4V cast cont RFGDT	0.50	0.64	0.71	0.46	0.46	0.53	0.13	0.09	0.28	0.61	0.45	0.31	0.50	0.44	0.35	0.43

Rt values of 20 μm scan line analysis

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	V	Aver
cpTi mach cont	0.26	0.29	0.34	0.68	0.69	0.89	0.65	0.41	0.50	0.84	0.56	0.65	0.39	0.47	0.74	0.56
cpTi mach cont RFGDT	0.52	0.63	0.59	0.32	0.32	0.32	0.35	0.36	0.30	0.77	2.82	0.40	0.67	0.75	0.54	0.47
Ti6Al4V mach cont	0.40	0.40	0.40	0.44	0.34	0.40	0.48	0.5	0.27	0.55	0.53	0.50	0.24	0.21	0.26	0.40
Ti6Al4V mach cont RFGDT	0.76	0.51	0.56	0.45	0.48	0.62	0.14	0.47	0.75	0.82	0.69	0.68	0.86	0.71	1.04	0.64
cpTi cast cont	2.85	1.95	1.30	2.35	3.86	1.94	2.02	1.91	1.53	1.97	3.06	2.63	1.28	0.87	2.68	2.15
cpTi cast cont RFGDT	2.41	4.27	4.10	2.28	2.35	2.52	1.77	2.74	2.76	2.67	3.75	5.07	2.38	2.32	1.64	2.87
Ti6Al4V cast cont	3.61	2.25	2.82	0.77	0.76	0.88	0.94	0.81	1.66	1.78	3.32	3.69	1.96	2.30	2.42	2.00
Ti6Al4V cast cont RFGDT	1.84	2.20	3.06	1.68	2.69	2.09	0.92	0.60	1.43	2.39	1.47	2.44	2.15	2.00	1.26	1.88

R_{tm} values of 20 μm scan line analysis

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	V	Aver
cpTi mach cont	0.15	0.15	0.18	0.26	0.27	0.30	0.23	0.16	0.16	0.52	0.25	0.24	0.17	0.19	0.26	0.23
cpTi mach cont RFGDT	0.29	0.32	0.30	0.17	0.16	0.21	0.18	0.17	0.18	0.32	0.15	0.20	0.29	0.26	0.22	0.23
Ti6Al4V mach cont	0.27	0.21	0.20	0.22	0.16	0.23	0.24	0.24	0.14	0.20	0.21	0.2	0.15	0.10	0.12	0.19
Ti6Al4V mach cont RFGDT	0.45	0.31	0.22	0.24	0.26	0.26	0.04	0.14	0.28	0.49	0.45	0.40	0.39	0.33	0.40	0.31
cpTi cast cont	1.31	1.02	0.65	0.73	1.45	1.13	1.04	1.07	0.80	1.06	1.48	1.14	0.59	0.42	1.34	1.02
cpTi cast cont RFGDT	1.42	1.62	1.55	1.25	0.82	0.98	0.86	1.54	1.13	1.53	1.78	2.11	0.85	0.85	0.57	1.26
Ti6Al4V cast cont	1.25	1.44	1.58	0.33	0.34	0.42	0.38	0.38	0.84	0.69	1.13	1.25	0.80	1.04	1.18	0.87
Ti6Al4V cast cont RFGDT	1.06	1.34	1.32	0.96	0.99	0.96	0.29	0.18	0.45	1.09	0.93	0.75	0.93	0.96	0.77	0.87

ADDENDUM E

Line Analysis - 5 μ m scans

Ra values of 5 μ m scan line analysis

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	V	Aver
cpTi mach cont	0.03	0.03	0.06	0.03	0.04	0.04	0.03	0.02	0.02	0.09	0.12	0.12	0.02	0.03	0.05	0.05
cpTi mach cont RFGDT	0.09	0.21	0.12	0.02	0.02	0.03	0.04	0.02	0.02	0.04	0.03	0.03	0.04	0.03	0.04	0.05
Ti6Al4V mach cont	0.07	0.07	0.07	0.04	0.05	0.07	0.12	0.09	0.10	0.08	0.06	0.08	0.04	0.05	0.05	0.07
Ti6Al4V mach cont RFGDT	0.08	0.12	0.11	0.05	0.08	0.06	0.04	0.02	0.02	0.09	0.08	0.15	0.06	0.06	0.06	0.07
cpTi cast cont	0.19	0.41	0.36	0.17	0.17	0.13	0.16	0.31	0.25	0.52	0.44	0.54	0.04	0.09	0.11	0.26
cpTi cast cont RFGDT	0.26	0.38	0.51	0.06	0.10	0.10	0.13	0.21	0.19	0.34	0.33	0.48	0.10	0.09	0.09	0.22
Ti6Al4V cast cont	0.23	0.09	0.21	0.09	0.08	0.08	0.43	0.25	0.27	0.37	0.18	0.50	0.27	0.26	0.32	0.24
Ti6Al4V cast cont RFGDT	0.21	0.27	0.26	0.16	0.22	0.18	0.05	0.04	0.03	0.16	0.15	0.16	0.13	0.14	0.14	0.15

Rp values of 5 μ m scan line analysis

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	V	Aver
cpTi mach cont	0.08	0.08	0.13	0.09	0.06	0.08	0.11	0.07	0.12	0.16	0.20	0.24	0.13	0.12	0.09	0.09
cpTi mach cont RFGDT	0.18	0.50	0.38	0.10	0.03	0.06	0.10	0.07	0.05	0.06	0.08	0.05	0.05	0.08	0.12	0.12
Ti6Al4V mach cont	0.10	0.11	0.08	0.08	0.07	0.08	0.16	0.15	0.24	0.09	0.11	0.14	0.10	0.09	0.11	0.11
Ti6Al4V mach cont RFGDT	0.22	0.28	0.16	0.17	0.19	0.15	0.10	0.04	0.04	0.28	0.30	0.28	0.16	0.16	0.16	0.16
cpTi cast cont	0.48	0.60	0.59	0.64	0.48	0.33	0.37	0.73	0.53	1.10	1.04	1.16	0.19	0.24	0.21	0.21
cpTi cast cont RFGDT	0.45	0.63	0.90	0.18	0.43	0.27	0.37	0.41	0.31	0.06	0.88	0.87	0.41	0.17	0.22	0.22
Ti6Al4V cast cont	0.68	0.25	0.41	0.23	0.17	0.19	0.73	0.72	0.56	0.60	0.62	1.22	0.40	0.49	0.52	0.52
Ti6Al4V cast cont RFGDT	0.51	0.73	0.48	0.37	0.59	0.34	0.09	0.10	0.07	0.26	0.26	0.24	0.32	0.25	0.20	0.20

Rpm values of 5µm scan line analysis

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	V	Aver
cpTi mach cont	0.03	0.03	0.08	0.05	0.04	0.04	0.03	0.02	0.03	0.03	0.05	0.07	0.04	0.05	0.05	0.04
cpTi mach cont RFGDT	0.04	0.15	0.10	0.02	0.01	0.03	0.05	0.02	0.02	0.03	0.03	0.02	0.03	0.05	0.04	0.04
Ti6Al4V mach cont	0.04	0.07	0.04	0.05	0.04	0.06	0.08	0.08	0.10	0.07	0.05	0.07	0.03	0.03	0.03	0.06
Ti6Al4V mach cont RFGDT	0.07	0.12	0.07	0.07	0.07	0.05	0.04	0.01	0.01	0.12	0.07	0.11	0.08	0.09	0.07	0.07
cpTi cast cont	0.14	0.22	0.27	0.13	0.19	0.07	0.11	0.21	0.17	0.36	0.35	0.37	0.06	0.08	0.13	0.19
cpTi cast cont RFGDT	0.22	0.32	0.33	0.06	0.12	0.11	0.19	0.15	0.13	0.30	0.23	0.26	0.09	0.03	0.04	0.17
Ti6Al4V cast cont	0.19	0.16	0.17	0.08	0.07	0.07	0.28	0.23	0.20	0.19	0.22	0.34	0.12	0.17	0.27	0.18
Ti6Al4V cast cont RFGDT	0.27	0.26	0.22	0.14	0.19	0.14	0.02	0.03	0.03	0.13	0.10	0.06	0.16	0.11	0.10	0.13

Rt values of 5 μ m scan line analysis

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	V	Aver
cpTi mach cont	0.15	0.16	0.32	0.23	0.21	0.24	0.21	0.13	0.16	0.33	0.39	0.46	0.20	0.18	0.24	0.24
cpTi mach cont RFGDT	0.32	0.82	0.55	0.20	0.06	0.20	0.19	0.12	0.10	0.16	0.17	0.13	0.16	0.18	0.22	0.24
Ti6Al4V mach cont	0.25	0.29	0.13	0.20	0.16	0.26	0.31	0.40	0.37	0.45	0.47	0.34	0.42	0.17	0.17	0.29
Ti6Al4V mach cont RFGDT	0.39	0.50	0.43	0.27	0.38	0.30	0.20	0.11	0.10	0.42	0.41	0.43	0.38	0.34	0.32	0.33
cpTi cast cont	0.91	1.46	1.18	0.95	0.83	0.55	0.77	1.31	0.89	1.76	1.79	2.16	0.30	0.55	0.47	1.06
cpTi cast cont RFGDT	1.21	1.69	2.23	0.29	0.72	0.54	0.75	0.92	0.72	1.33	1.34	1.54	0.60	0.36	0.41	0.98
Ti6Al4V cast cont	0.94	0.58	0.89	0.41	0.34	0.35	1.45	1.34	1.04	1.28	1.10	2.37	1.37	1.11	1.21	1.05
Ti6Al4V cast cont RFGDT	0.97	1.17	1.16	1.02	0.96	0.70	0.20	0.18	0.15	0.56	0.53	0.48	0.59	0.61	0.57	0.66

Rtm values of 5 μ m scan line analysis

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	V	Aver
cpTi mach cont	0.06	0.07	0.17	0.12	0.10	0.12	0.07	0.05	0.06	0.10	0.12	0.15	0.07	0.08	0.10	0.10
cpTi mach cont RFGDT	0.07	0.28	0.20	0.05	0.05	0.08	0.12	0.06	0.05	0.08	0.07	0.04	0.07	0.11	0.10	0.10
Ti6Al4V mach cont	0.08	0.13	0.12	0.09	0.14	0.11	0.17	0.17	0.19	0.21	0.12	0.18	0.06	0.06	0.07	0.13
Ti6Al4V mach cont RFGDT	0.16	0.23	0.18	0.13	0.15	0.12	0.08	0.03	0.04	0.21	0.14	0.25	0.19	0.21	0.14	0.15
cpTi cast cont	0.32	0.48	0.62	0.26	0.35	0.13	0.24	0.42	0.30	0.68	0.68	0.73	0.12	0.20	0.02	0.37
cpTi cast cont RFGDT	0.53	0.67	0.70	0.13	0.26	0.22	0.35	0.29	0.27	0.56	0.46	0.51	0.15	0.07	0.08	0.35
Ti6Al4V cast cont	0.37	0.28	0.31	0.16	0.15	0.16	0.54	0.46	0.35	0.41	0.47	0.65	0.28	0.37	0.55	0.37
Ti6Al4V cast cont RFGDT	0.55	0.43	0.45	0.33	0.34	0.35	0.06	0.07	0.06	0.22	0.21	0.13	0.34	0.22	0.19	0.26

ADDENDUM F

Spreadsheet for the Depth profile and Chemical analysis

MATER	FABRIC	SURFACE	TREAT	DEPTH_P	M2Ti	M2C	M2O	M2Al	M2Na	M2Zn	M2Pb	M2Ca	M2N	M2V	M2Zr
1	1	1	1	2.8	11.23	37.7	45.82	0.1	0	2.72	0.52	0.62	1.38		
1	1	1	2	4.2	21.64	20.75	56.44	0.1	0			0.1	0.8		0.37
1	1	2	1	4.2	7.19	41.47	43.62	5.2	0	0.49		0.36			
1	1	2	2	7.7	12.97	19.94	52.73	9.69	0			0.32			
1	1	3	1	5.6	8.78	29.53	51.43	5.78	0	1.41		0.97			
1	1	3	2	8.4	14.73	15.12	55.91	7.47	0			0.38			
1	2	1	1	6.3	5.26	23.6	53.62	12.71	4.58			0.23			
1	2	1	2	6.3	9.21	15.09	57.86	12.93	4.74			0.35			0.17
1	2	2	1	5.6	4.29	37.31	43.96	10.48	2.22	0.21		0.47	1.07		
1	2	2	2	8.4	14.59	15.52	56.3	8.22	4.47			0.39			0.51
1	2	3	1	5.25	7.09	25.6	52.96	9.84	3.33	0.66		0.52			
1	2	3	2	8.4	12.91	23.09	51.31	7.97	3.04			0.5	0.93		0.25
2	1	1	1	1.925	10.27	36.83	48.68	1.04	0	2.07	0.34	0.32	0.46	0.89	
2	1	1	2	2.8	18.8	21.77	56.69	1.18	0			0.1			0.67
2	1	2	1	6.3	4.19	36.68	43.83	8.68	5.9			0.24	0.48		
2	1	2	2	6.65	12.97	14.94	55.26	9.77	6.16	0.18		0.31			0.4
2	1	3	1	6.3	5.49	29.2	52.19	9.47	0	0.65		0.75			
2	1	3	2	7	13.73	16.05	55.49	9.2	0			0.3			
2	2	1	1	5.95	5.61	28.67	51.42	9.61	3.27			0.44	0.77	0.21	
2	2	1	2	7.4	6.16	25.31	55.36	10.53	1.49			1.03			0.12
2	2	2	1	4.2	8.35	32.68	47.7	8.01	2.17	0.14		0.2	0.74		
2	2	2	2	5.6	9.87	14.86	55.45	15.09	3.51			0.06			0.35
2	2	3	1	5.95	4.84	28.93	52.24	10.11	2.35	0.49		0.6	0.44		
2	2	3	2	8.4	12.61	15.94	56.55	10.85	3.22			0.41			0.41

Spreadsheet for Surface topography

Area analysis

MATER	FABRIC	SURFACE	TREAT	M3Ra	M3RMS	M3HEIG	M3RAN	M3SUR	M3Ra_1	M3RMS_1	M3HEIG_1	M3RAN_1	M3SUR_1
1	1	1	1	0.14	0.17	0.58	1.04	416.18	0.06	0.07	0.27	0.51	27.15
1	1	1	2	0.09	0.13	0.45	0.95	416.34	0.07	0.08	0.22	0.43	26.56
1	2	1	1	0.52	0.65	1.88	3.94	531.92	0.26	0.32	0.68	1.61	32.86
1	2	1	2	0.65	0.9	2.21	4.56	559.14	0.27	0.34	0.8	1.78	34.2
2	1	1	1	0.09	0.11	0.63	0.93	415	0.08	0.1	0.35	0.53	27.31
2	1	1	2	0.14	0.18	0.53	1.21	425.02	0.11	0.13	0.31	0.68	28.04
2	2	1	1	0.45	0.55	1.74	3.3	508.26	0.09	0.31	0.75	1.65	34.94
2	2	1	2	0.41	0.52	1.92	3.67	535.26	0.2	0.25	0.58	1.32	32.39

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Line analysis

MATER	FABRIC	SURFACE	TREAT	LARA	LARTM	LART	LARPM	LARP	LARA_1	LARTM_1	LART_1	LARPM_1	LARP_1	p_SUR_A
1	1	1	1	0.125	0.237	0.561	0.114	0.254	0.053	0.102	0.245	0.046	0.123	104.04
1	1	1	2	0.089	0.233	0.478	0.117	0.243	0.056	0.1	0.244	0.048	0.131	104.08
1	2	1	1	0.126	0.314	0.641	0.151	0.311	0.077	0.154	0.337	0.076	0.184	132.75
1	2	1	2	0.407	1.02	2.152	0.508	0.983	0.264	0.376	1.063	0.195	0.584	139.78
2	1	1	1	0.085	0.199	0.401	0.089	0.183	0.074	0.132	0.298	0.06	0.118	103.75
2	1	1	2	0.126	0.314	0.641	0.151	0.311	0.077	0.154	0.337	0.076	0.184	106.25
2	2	1	1	0.392	0.874	2.001	0.409	0.833	0.246	0.371	1.057	0.189	0.523	127.06
2	2	1	2	0.344	0.87	1.885	0.436	0.98	0.158	0.268	0.661	0.136	0.326	133.81

Spreadsheet for % attachment efficiency and proliferation

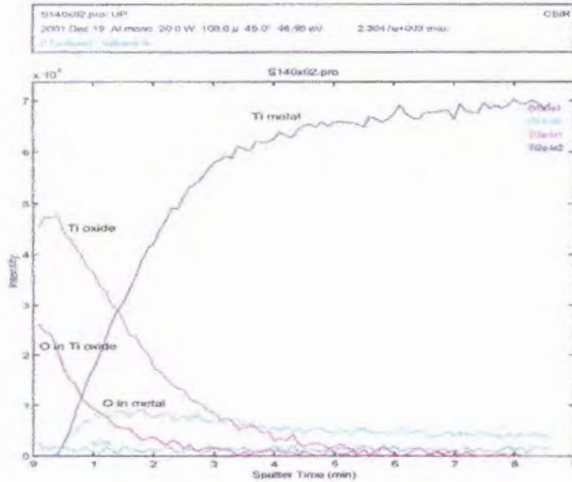
Surface	Time	Fibro	Osteo
1	1	37.81	
1	2	60.91	129.09
1	14	95.36	156.36
1	28	131.38	52.83
2	1	26.78	
2	2	31.06	108.41
2	14	141.78	113.84
2	28	120.04	59.29
3	1	35.05	
3	2	47.26	103.13
3	14	137.26	143.64
3	28	135.4	24.24
4	1	36.46	
4	2	47.26	89.02
4	14	144.61	148.18
4	28	44.42	39.54
5	1	43.06	
5	2	44.76	108.48
5	14	96.88	112.73
5	28	51.25	114.55
6	1	58.6	
6	2	35.28	105.77
6	14	102.92	100.91
6	28	37.28	25.45
7	1	44.11	
7	2	40.88	95.86
7	14	138.94	220.0
7	28	56.05	56.46
8	1	37.66	
8	2	52.32	72.73
8	14	186.2	135.45
8	28	67.34	200.0
9	1	32.41	
9	2	48.07	67.27
9	14	160.68	182.73
9	28	95.7	150.0
10	1		
10	2		96.82
10	14		243.64
10	28		47.47
11	1	45.26	
11	2	56.71	114.55
11	14	126.65	192.73
11	28	39.07	55.43
12	1	39.91	
12	2	42.8	69.82
12	14	113.89	190.91
12	28	54.48	174.55
13	1	45.52	
13	2	58.01	113.81
13	14	115.72	187.67
13	28	126.96	27.27



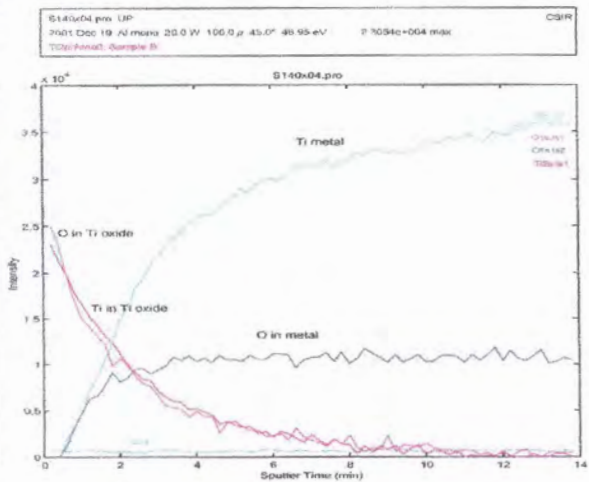
ADDENDUM G

Depth profile

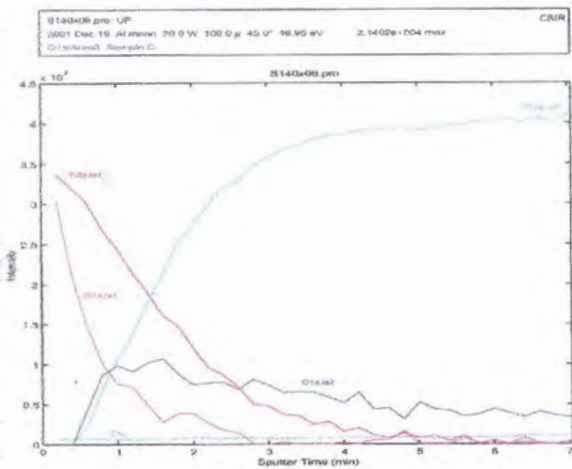
Before RFGDT



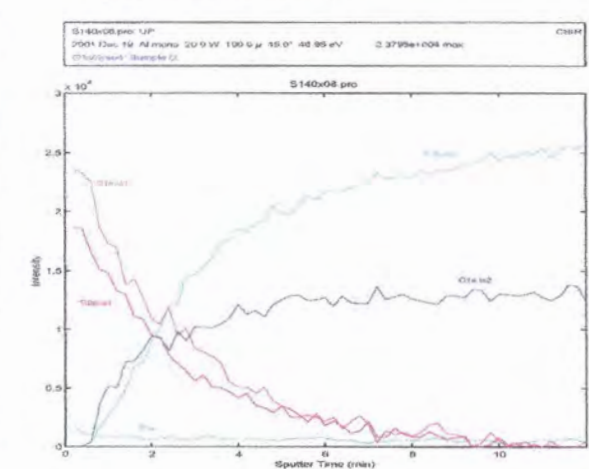
cpTi machined control sample



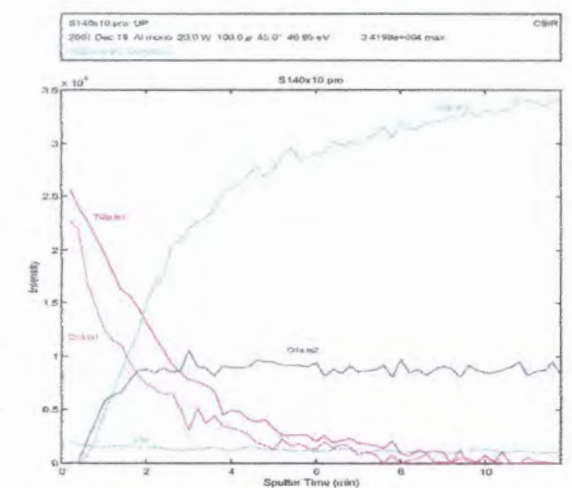
cpTi machined ES sample



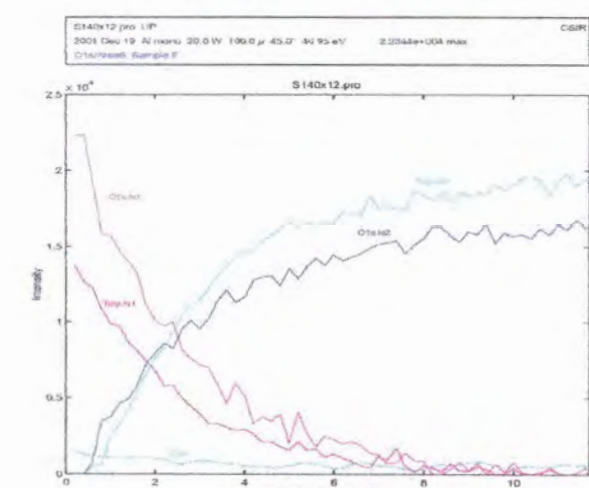
Ti6Al4V machined control sample



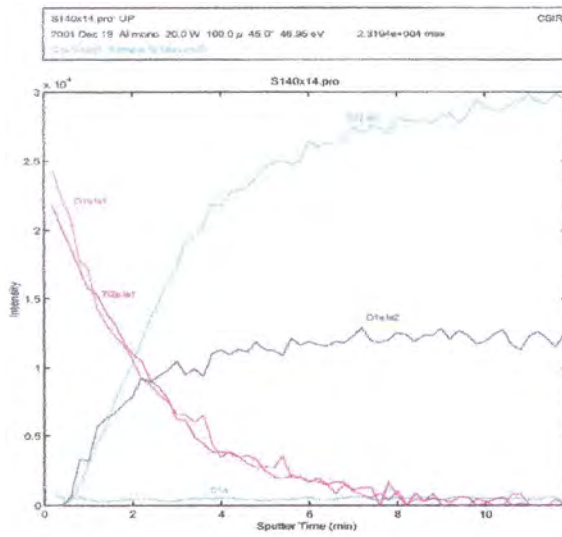
Ti6Al4V machined ES sample



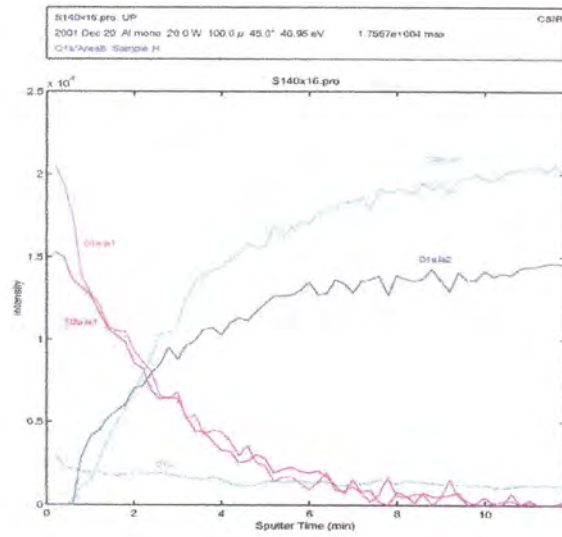
cpTi machined SI sample



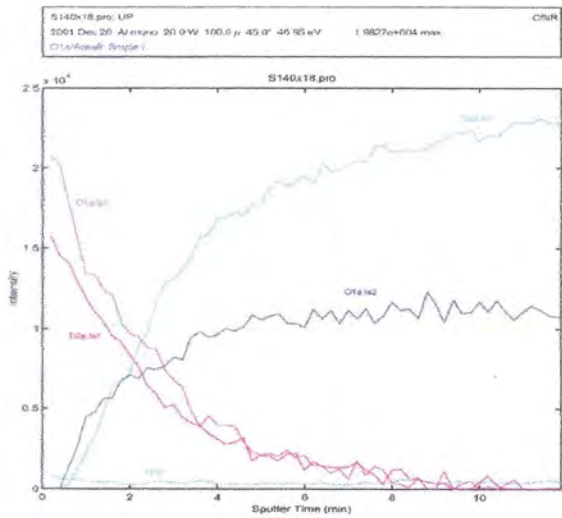
cpTi cast control sample



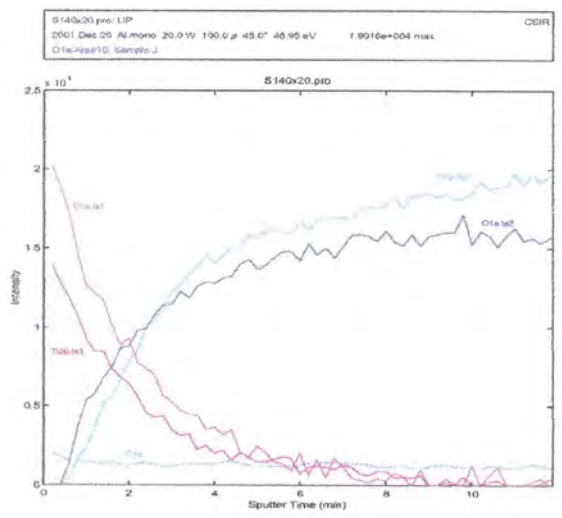
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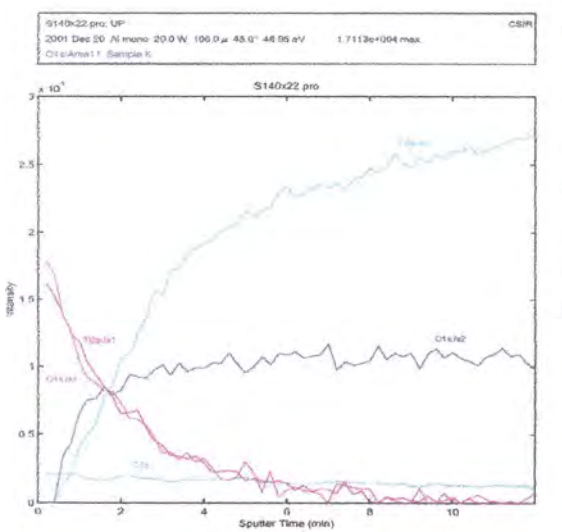
Ti6Al4V cast control sample



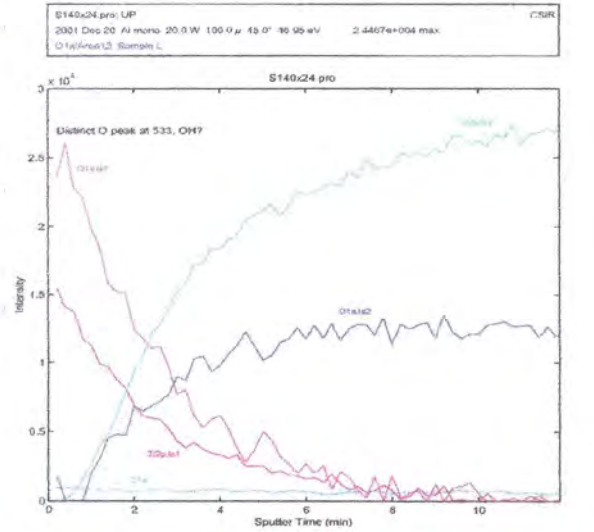
Ti6Al4V cast ES sample



cpTi cast SI sample



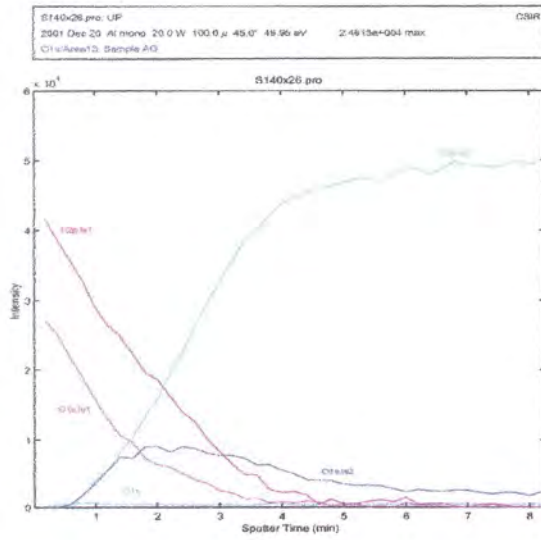
Ti6Al4V cast SI sample



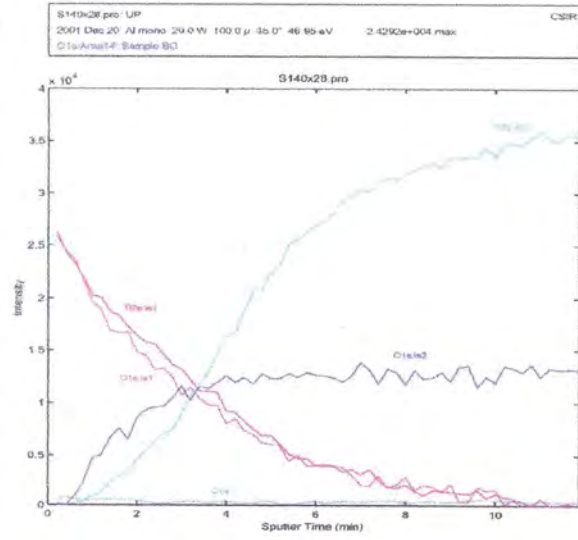
Ti6Al4V machined SI sample



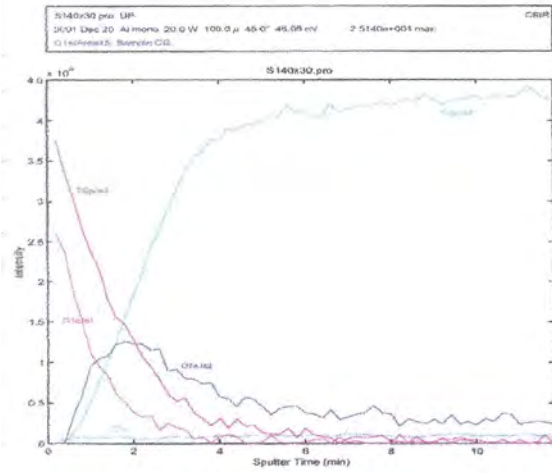
After RFGDT



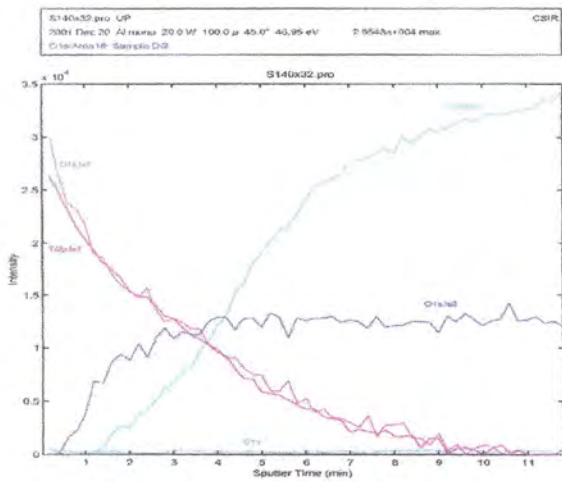
cpTi machined control RFGDT sample



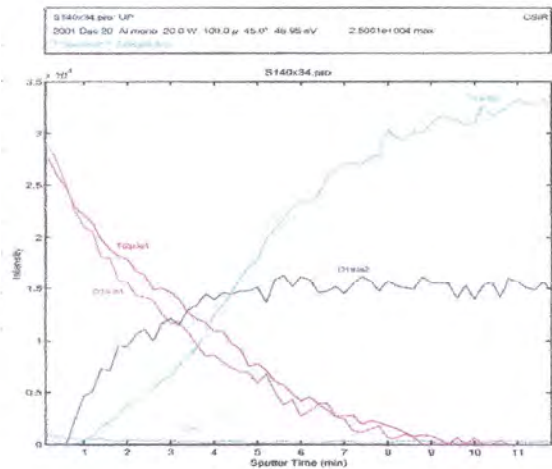
cpTi machined ES RFGDT sample



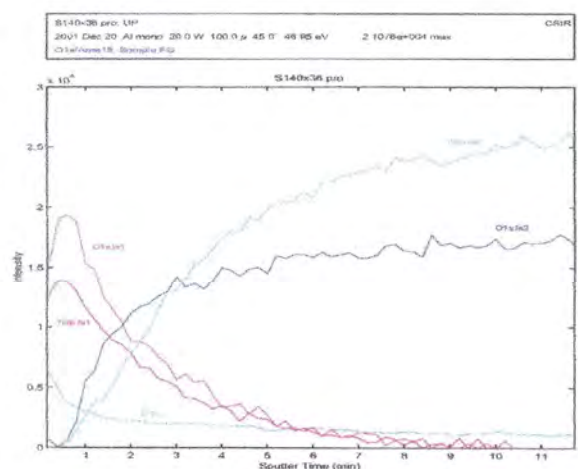
Ti6Al4V machined control RFGDT sample



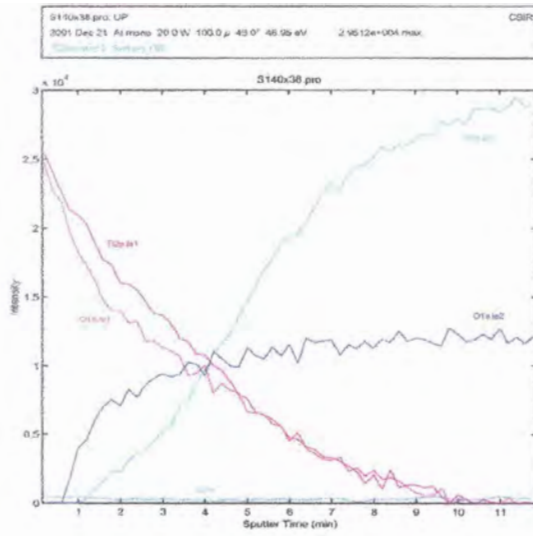
Ti6Al4V machined ES RFGDT sample



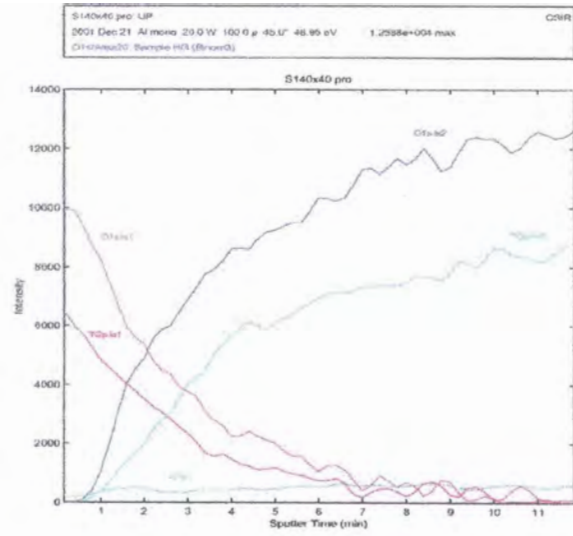
cpTi machined SI RFGDT sample



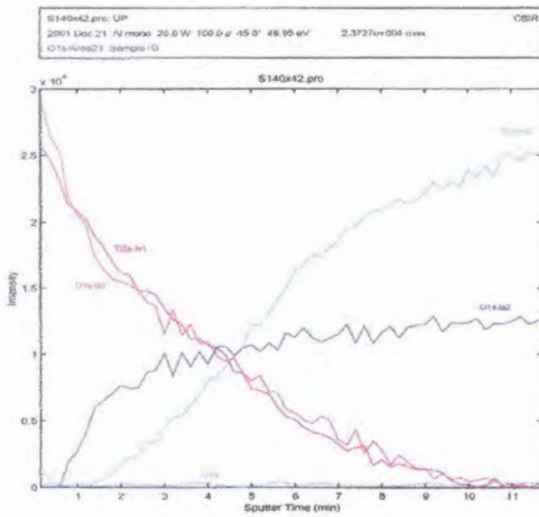
cpTi cast control RFGDT sample



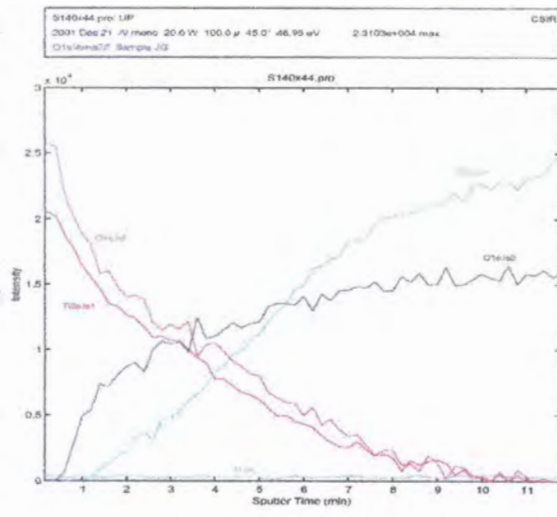
cpTi cast ES RFGDT sample



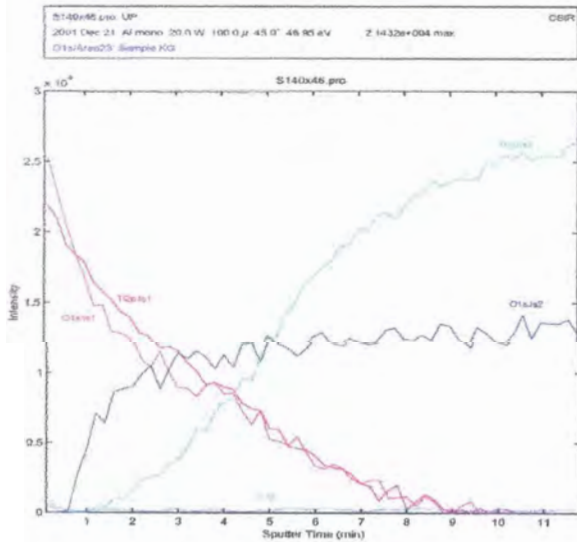
Ti6Al4V cast control RFGDT sample



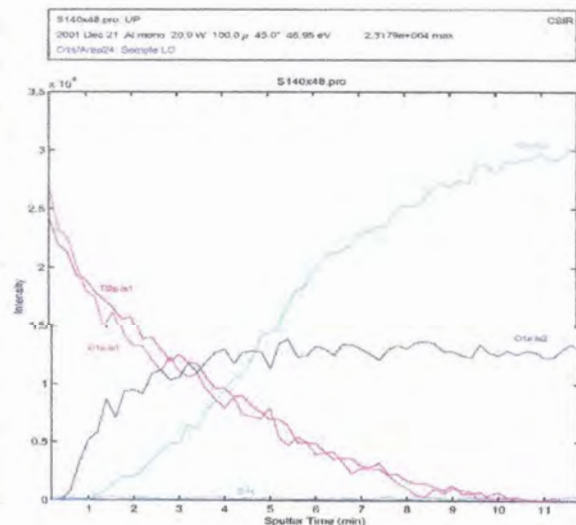
Ti6Al4V cast ES RFGDT sample



cpTi cast SI RFGDT sample



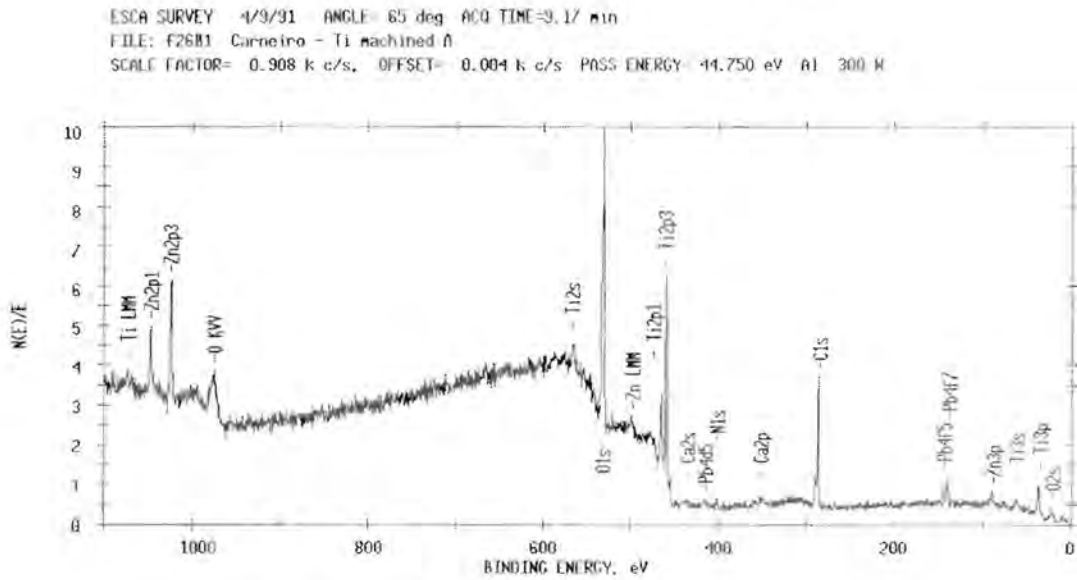
Ti6Al4V cast SI RFGDT sample



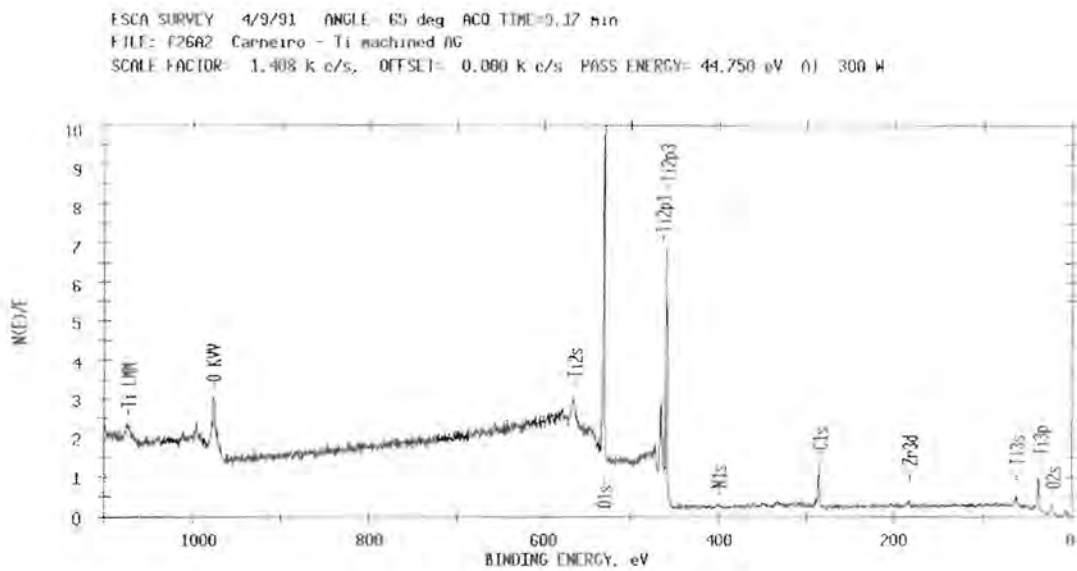
Ti6Al4V machined SI RFGDT sample

ADDENDUM H

XPS Spectra

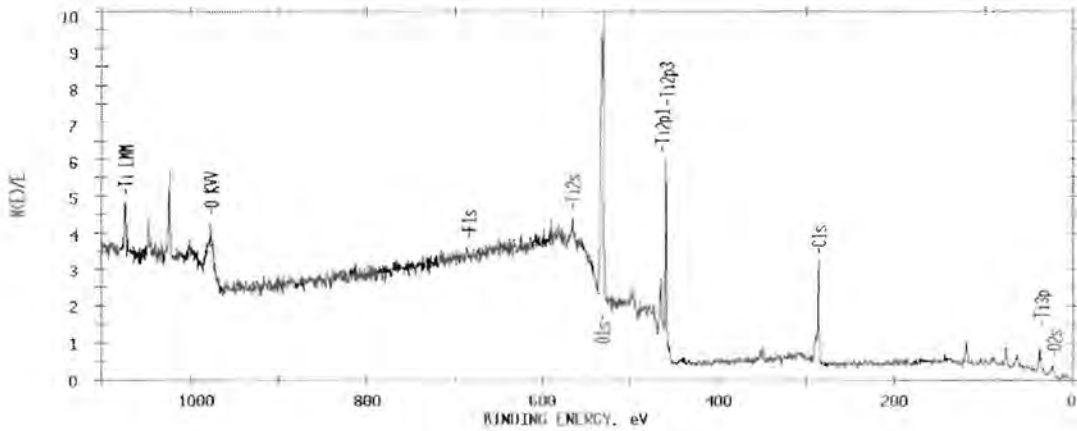


cpTi machined control sample



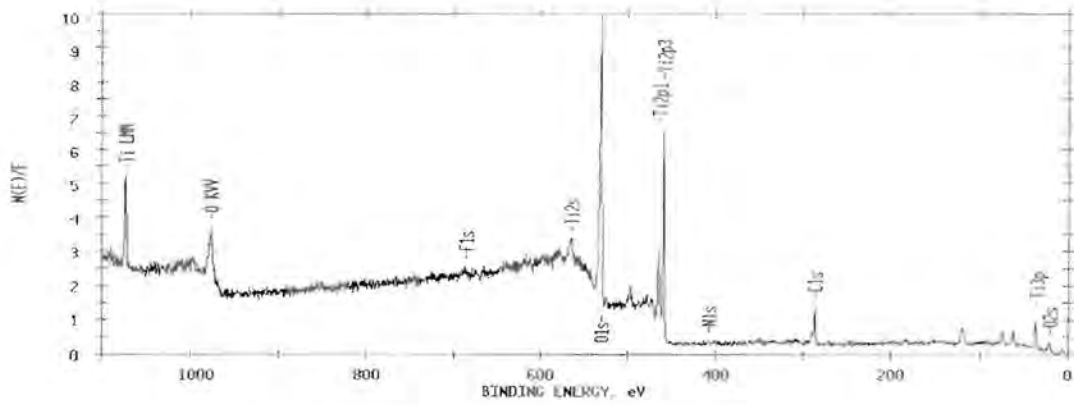
cpTi machined control RFGDT sample

ESCA SURVEY 8/27/91 ANGLE= 65 deg ACQ TIME=9.17 min
FILE: F20A1 LC - B Ti machined enhanced
SCALE FACTOR= 0.940 k c/s, OFFSET= 0.004 k c/s PASS ENERGY= 44.750 eV AI 300 H



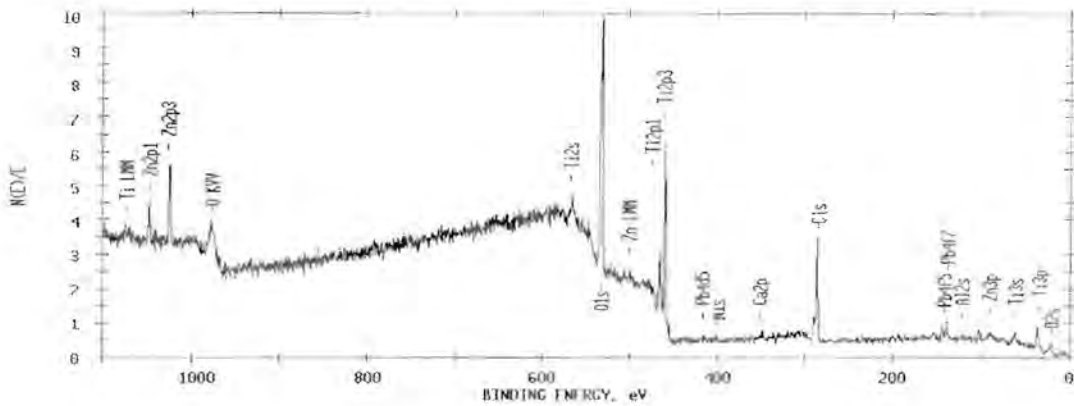
cpTi machined ES control sample

ESCA SURVEY 8/27/91 ANGLE= 65 deg ACQ TIME=9.17 min
FILE: F20B2 LC - BG Ti machined enhanced RFGD
SCALE FACTOR= 1.114 k c/s, OFFSET= 0.000 k c/s PASS ENERGY= 44.750 eV AI 300 H



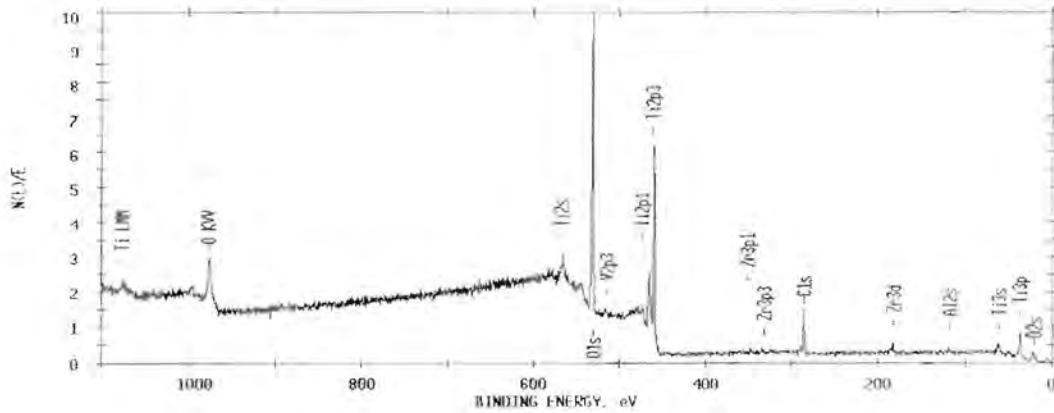
cpTi machined ES control RFGD sample

ESCA SURVEY 4/10/91 ANGLE= 65 deg ACQ TIME=9.17 min
FILE: F27C1 Carneiro - Ti alloy machined C
SCALE FACTOR= 0.885 k c/s, OFFSET= 0.004 k c/s PASS ENERGY= 44.750 eV AI 300 H



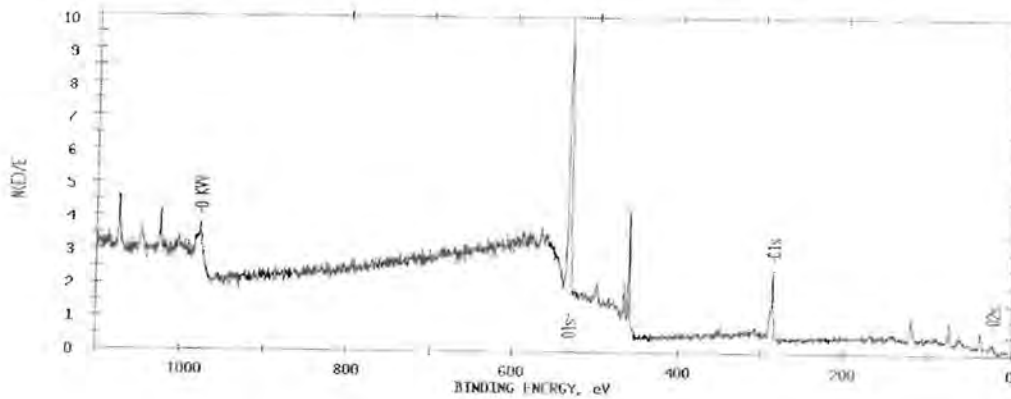
Ti6Al4V machined control sample

ESCA SURVEY 4/10/91 ANGLE= 65 deg ACQ TIME=9.17 min
FILE: F2701 Carneiro - Ti Alloy machined CG
SCALE FACTOR= 1.436 k c/s. OFFSET= 0.000 k c/s PASS ENERGY= 14.750 eV Al 300 W



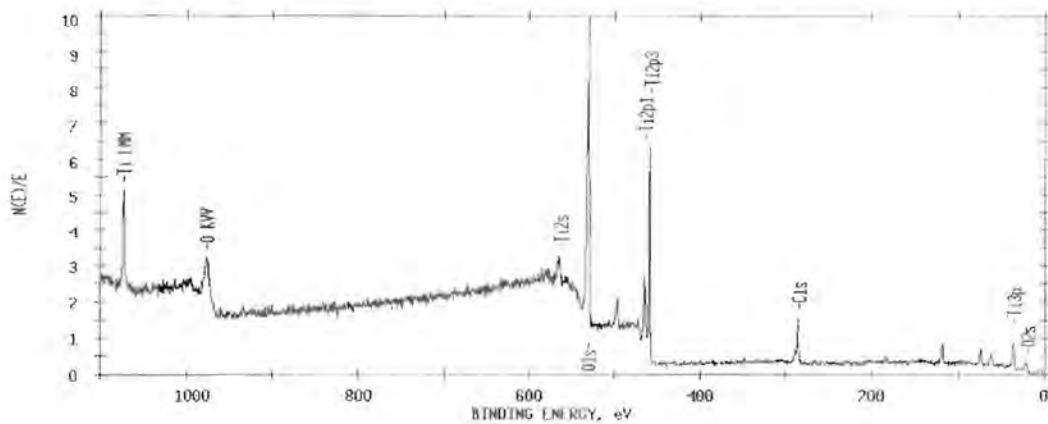
Ti6Al4V machined control RFGDT sample

ESCA SURVEY 8/27/91 ANGLE= 65 deg ACQ TIME= 9.17 min
FILE: F20C1 LC - D Ti alloy machined enhanced
SCALE FACTOR= 0.871 k c/s. OFFSET= 0.000 k c/s PASS ENERGY= 14.750 eV Al 300 W



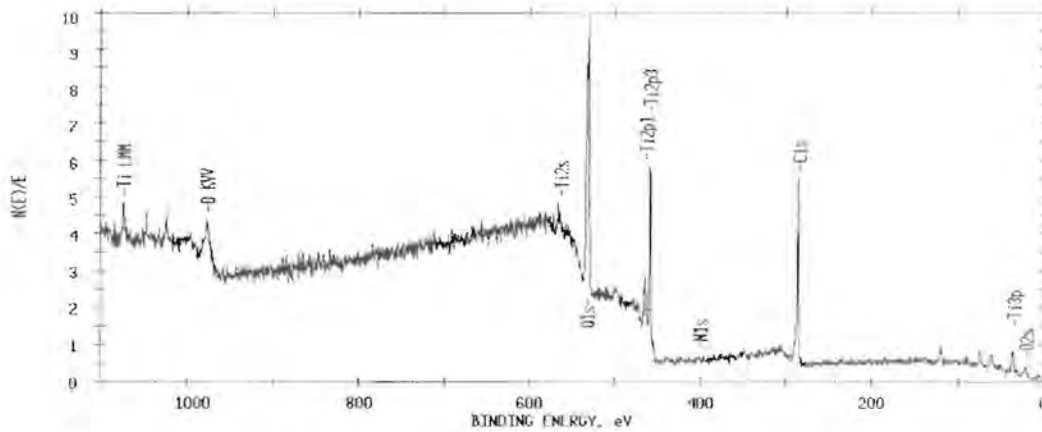
Ti6Al4V machined ES control sample

ESCA SURVEY 8/27/91 ANGLE= 65 deg ACQ TIME=9.17 min
FILE: F2001 LC - DG Ti alloy machined enhanced RFGD
SCALE FACTOR= 1.365 k c/s. OFFSET= 0.000 k c/s PASS ENERGY= 14.750 eV Al 300 W



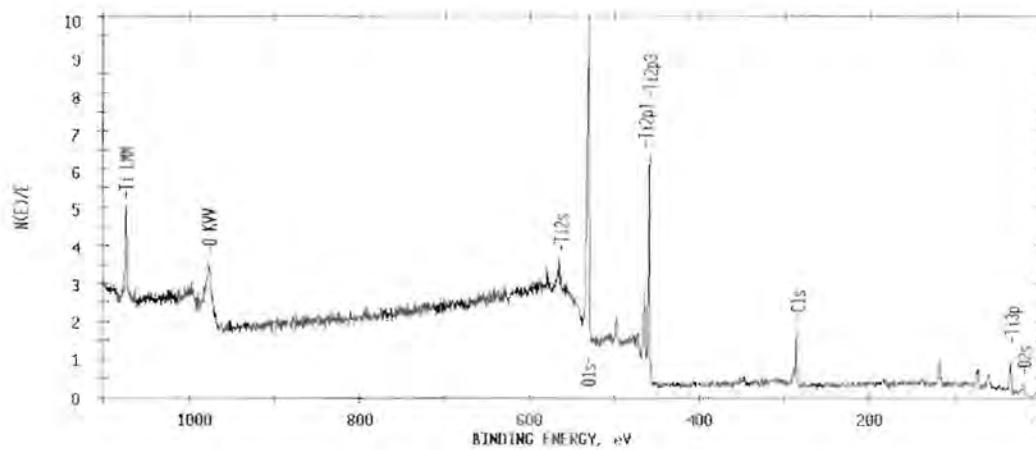
Ti6Al4V machined ES RFGDT sample

ESCA SURVEY 8/27/91 ANGLE= 65 deg ACO TIME=9.17 min
FILE: F20E1 LC - E Ti machined enhanced SI
SCALE FACTOR= 0.916 k c/s, OFFSET= 0.001 k c/s PASS ENERGY= 44.750 eV Al 300 W



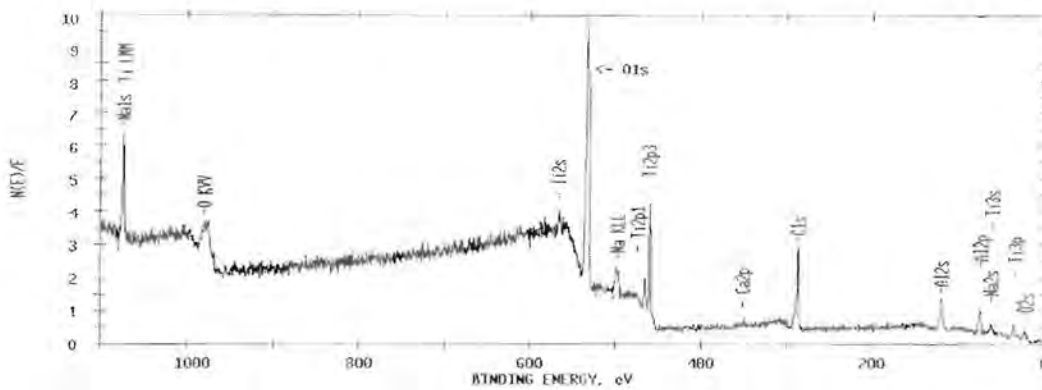
cpTi machined SI sample

ESCA SURVEY 8/27/91 ANGLE= 65 deg ACO TIME=9.17 min
FILE: F20F1 LC - EG Ti machined enhanced SI RFGD
SCALE FACTOR= 1.157 k c/s, OFFSET= 0.000 k c/s PASS ENERGY= 44.750 eV Al 300 W



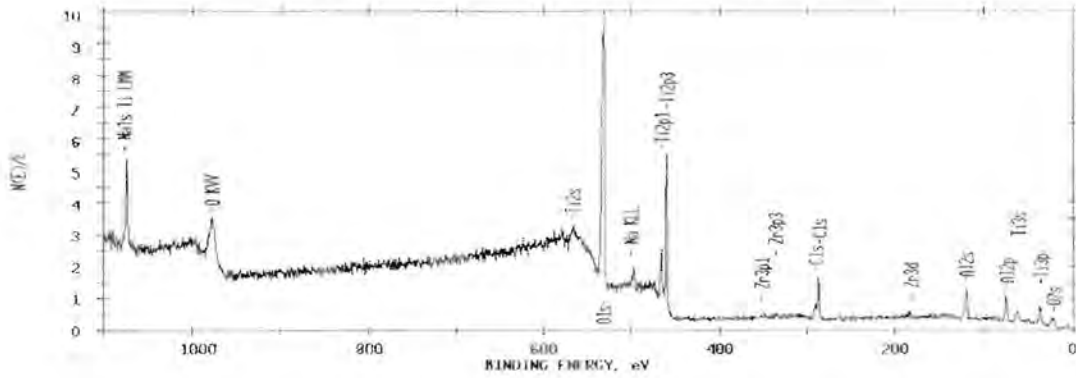
cpTi machined SI RFGD sample

ESCA SURVEY 4/10/91 ANGLE= 65 deg ACO TIME=9.17 min
FILE: F2/11 Carneiro - Ti F
SCALE FACTOR= 0.759 k c/s, OFFSET= 0.004 k c/s PASS ENERGY= 44.750 eV Al 300 W



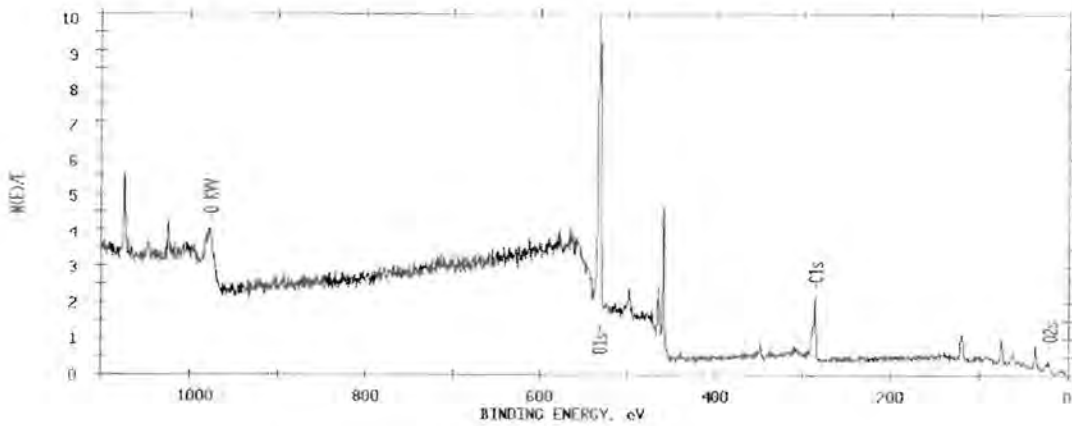
cpTi cast control sample

ESCA SURVEY 4/10/91 ANGLE= 65 deg ACQ TIME= 9.17 min
FILE: F2/H1 Carneiro - Ti FG
SCALE FACTOR= 0.903 k c/s. OFFSET= 0.004 k c/s PASS ENERGY= 44.750 eV AT 300 W



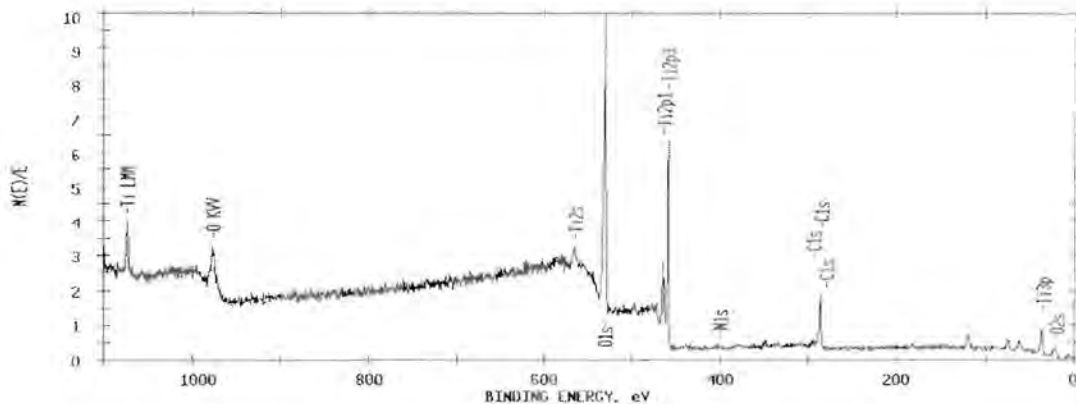
cpTi cast control RFGDT sample

ESCA SURVEY 8/28/91 ANGLE= 65 deg ACQ TIME= 9.17 min
FILE: F21A1 LC - G Ti cast enhanced
SCALE FACTOR= 0.930 k c/s. OFFSET= 0.004 k c/s PASS ENERGY= 44.750 eV AT 300 W



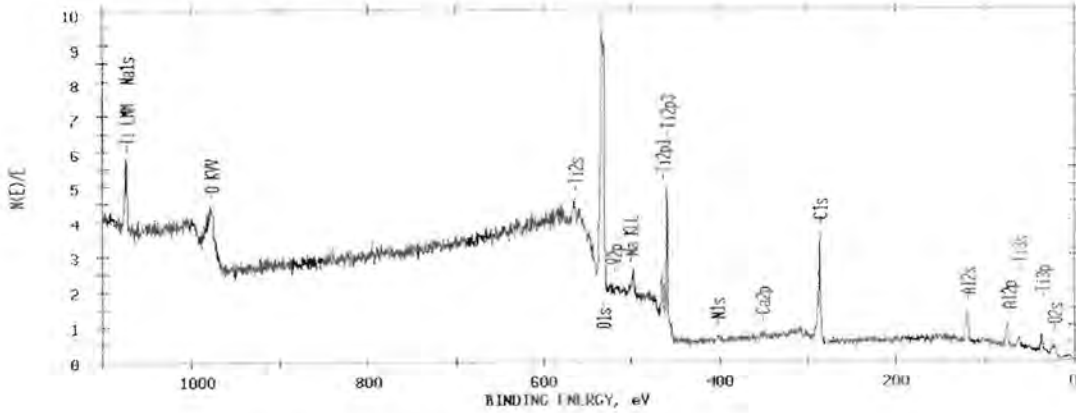
cpTi cast ES sample

ESCA SURVEY 8/28/91 ANGLE= 65 deg ACQ TIME= 9.17 min
FILE: F21B21 LC - GG to cast enhanced RFGD
SCALE FACTOR= 1.142 k c/s. OFFSET= 0.000 k c/s PASS ENERGY= 44.750 eV AT 300 W



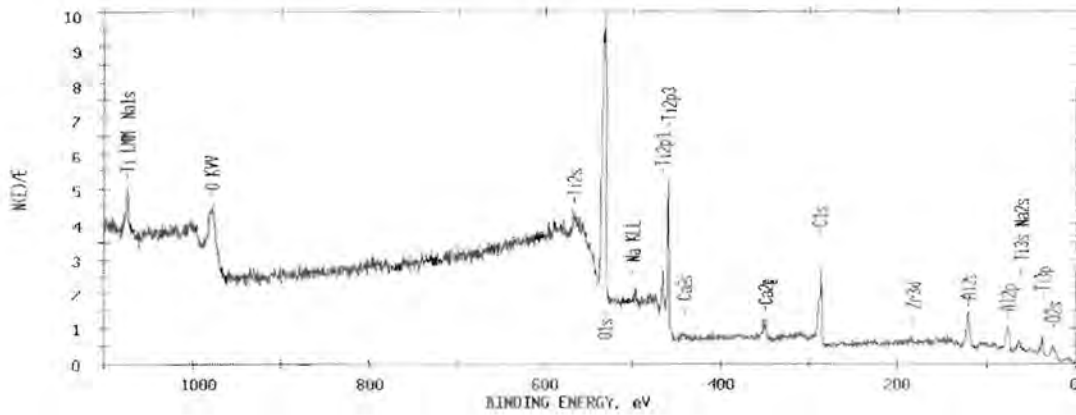
cpTi cast ES RFGDT sample

ESCA SURVEY 4/23/91 ANGLE= 65 deg ACO TIME=9.17 min
FILE: F10A1 Carneiro - Ti cast alloy H repeat
SCALE FACTOR= 0.965 k c/s. OFFSET= 0.012 k c/s PASS ENERGY= 44.750 eV AI 300 W

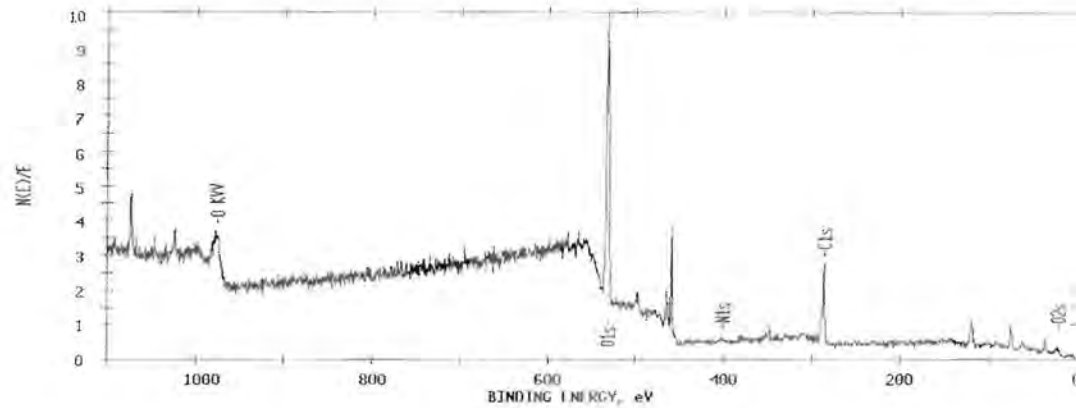


Ti6Al4V cast control sample

ESCA SURVEY 4/15/91 ANGLE= 65 deg ACO TIME=14.67 min
FILE: F32C3 Carneiro - Ti alloy cast HC
SCALE FACTOR= 0.682 k c/s. OFFSET= 0.005 k c/s PASS ENERGY= 44.750 eV AI 300 W

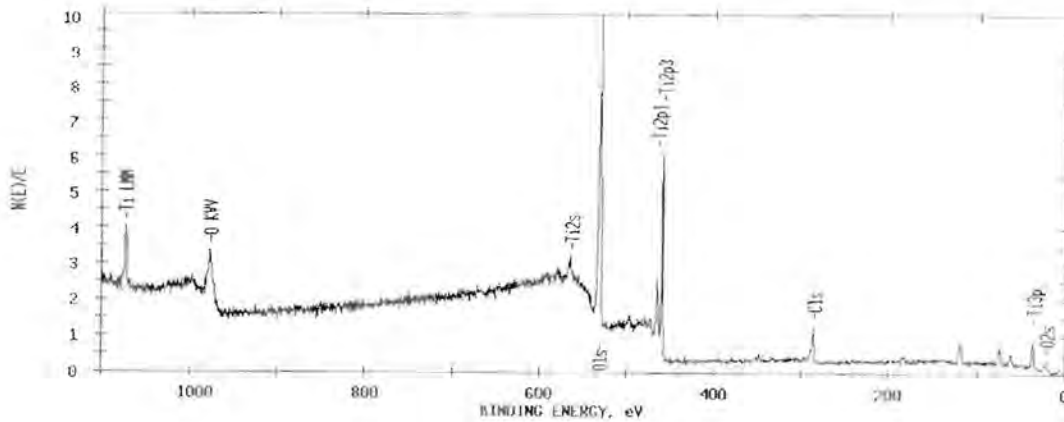


ESCA SURVEY 8/28/91 ANGLE= 65 deg ACO TIME=9.17 min
FILE: F21C1 IC - I Ti alloy cast enhanced
SCALE FACTOR= 0.845 k c/s. OFFSET= 0.000 k c/s PASS ENERGY= 44.750 eV AI 300 W



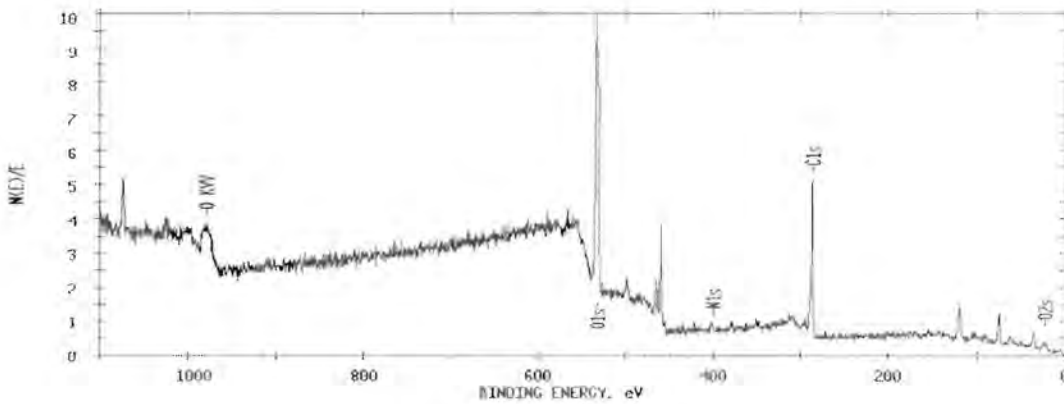
Ti6Al4V cast ES sample

ESCA SURVEY 8/28/91 ANGLE= 65 deg ACO TIME=9.17 min
FILE: F21D1 LC - 16 Ti alloy cast enhanced RFGD
SCALE FACTOR= 1.200 k c/s. OFFSET= 0.000 k c/s PASS ENERGY= 44.750 eV AT 300 W



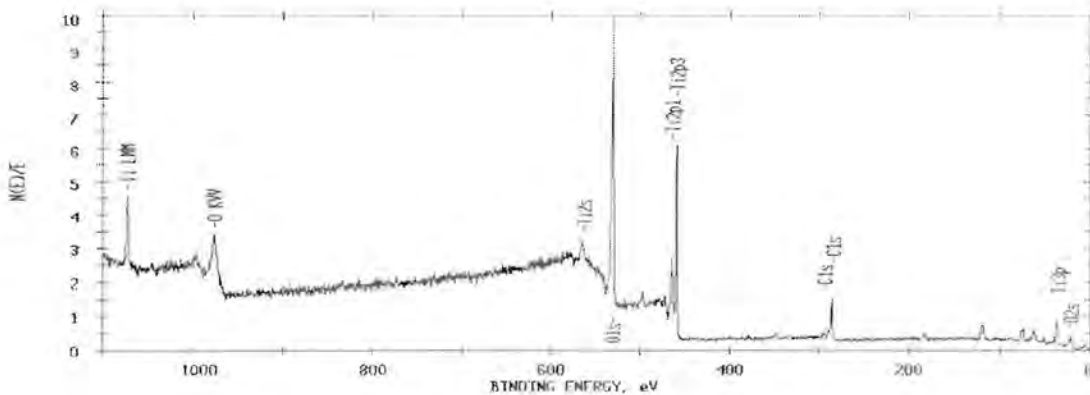
Ti6Al4V cast ES RFGDT sample

ESCA SURVEY 8/29/91 ANGLE= 65 deg ACO TIME=9.17 min
FILE: F22C1 LC - J Ti cast SI enhanced
SCALE FACTOR= 0.884 k c/s. OFFSET= 0.000 k c/s PASS ENERGY= 44.750 eV AT 300 W



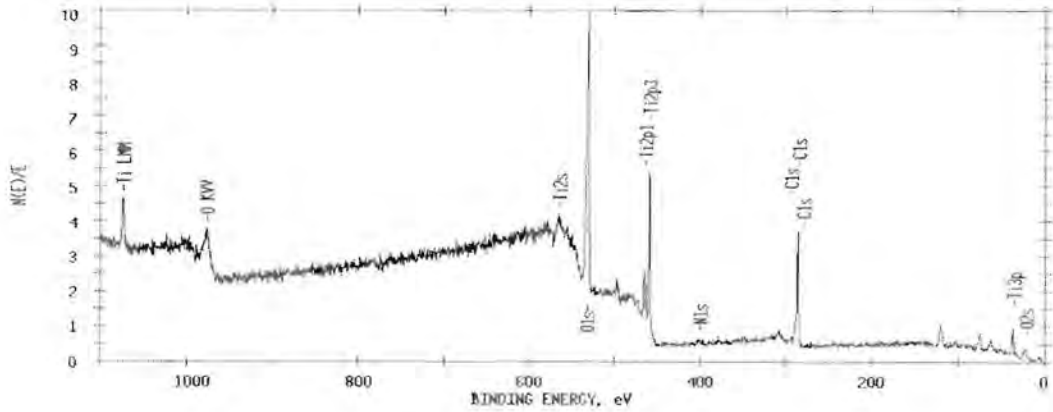
cpTi cast SI sample

ESCA SURVEY 8/29/91 ANGLE= 65 deg ACO TIME=9.17 min
FILE: F22D1 LC - J6 Ti cast SI enhanced RFGD
SCALE FACTOR= 1.572 k c/s. OFFSET= 0.000 k c/s PASS ENERGY= 44.750 eV AT 300 W



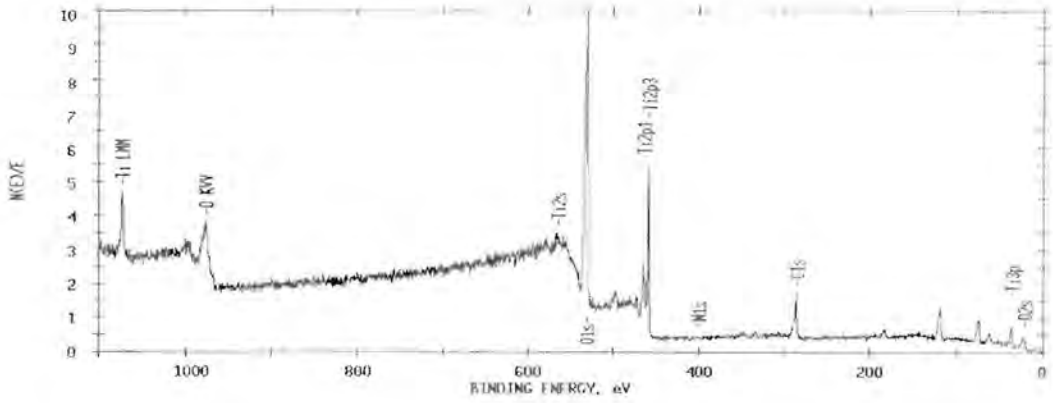
cpTi cast SI RFGDT sample

ESCA SURVEY 8/29/91 ANGLE= 65 deg ACO TIME=9.17 min
FILE: F22E1 LC - K Ti alloy cast SI enhanced
SCALE FACTOR= 1.219 k c/s. OFFSET= 0.016 k c/s PASS ENERGY= 44.750 eV A1 300 W



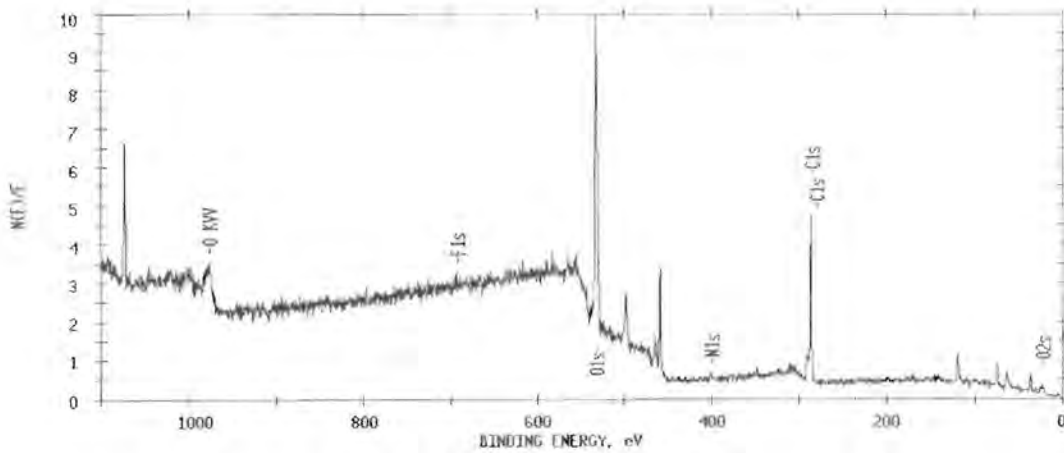
Ti6Al4V cast SI sample

ESCA SURVEY 8/29/91 ANGLE= 65 deg ACO TIME=9.17 min
FILE: F22F1 LC - K Ti alloy cast SI enhanced RFGD
SCALE FACTOR= 1.205 k c/s. OFFSET= 0.000 k c/s PASS ENERGY= 44.750 eV A1 300 W



Ti6Al4V cast SI RFGD sample

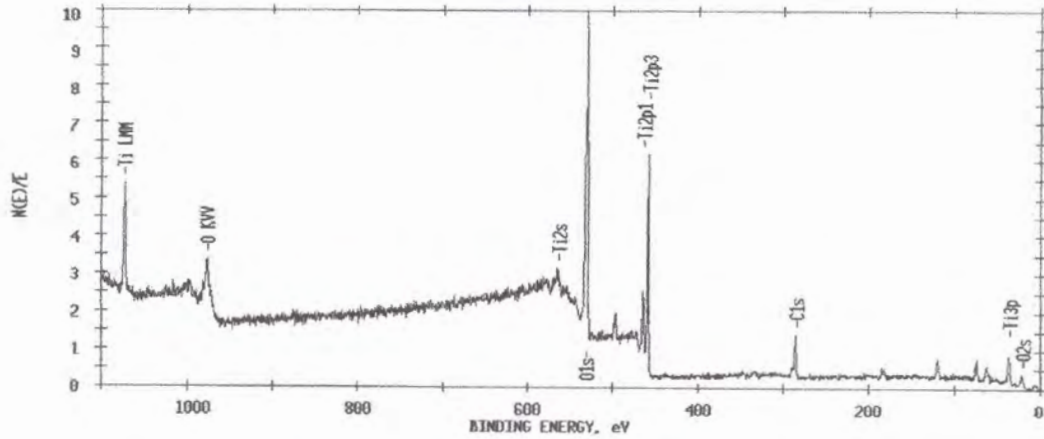
ESCA SURVEY 8/30/91 ANGLE= 65 deg ACO TIME=9.17 min
FILE: F22G1 LC - L Ti alloy machined enhanced SI
SCALE FACTOR= 0.807 k c/s. OFFSET= 0.000 k c/s PASS ENERGY= 44.750 eV A1 300 W



Ti6Al4V machined SI sample



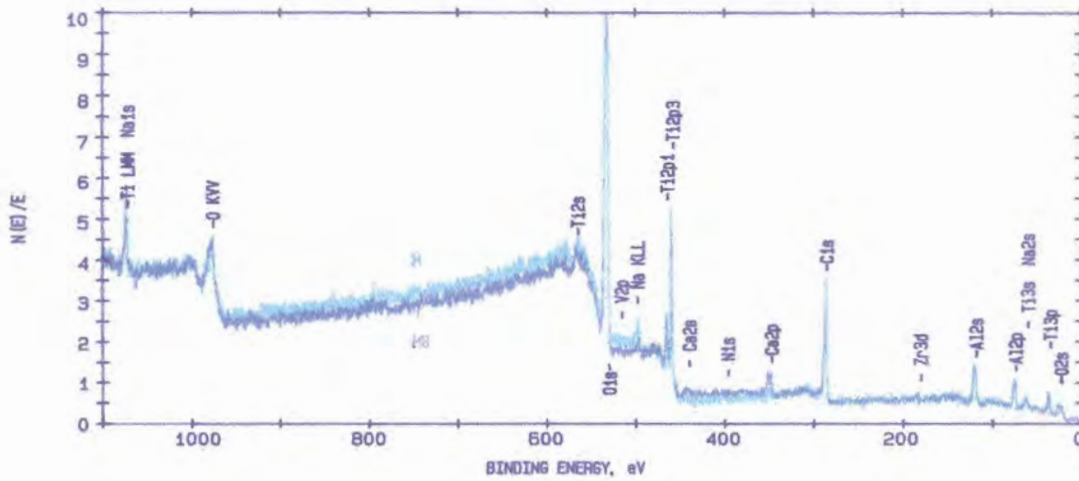
ESCA SURVEY 8/30/91 ANGLE= 65 deg ACQ TIME=9.17 min
FILE: f23a1 LC - LG Ti alloy machined enhanced SI RFGD
SCALE FACTOR= 1.303 k c/s, OFFSET= 0.000 k c/s PASS ENERGY= 44.750 eV A1 300 W



Ti6Al4V machined SI RFGDT sample

Comparison of different samples

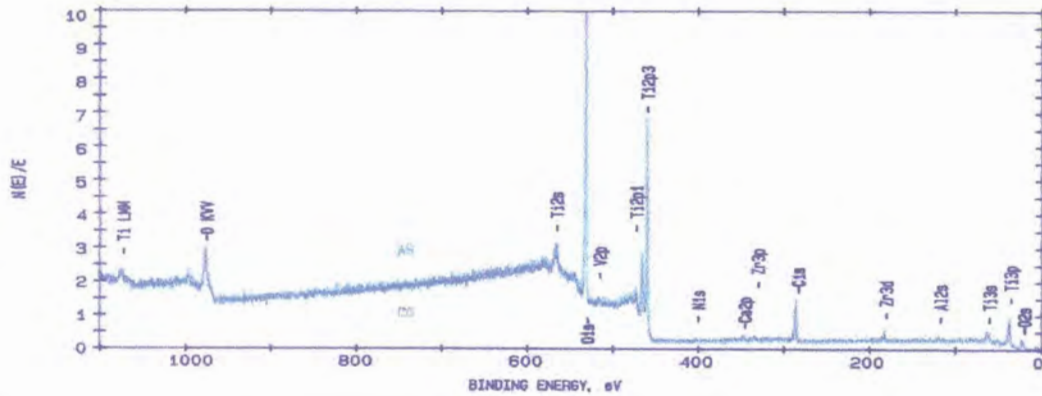
ESCA SURVEY 4/15/91 ANGLE= 65 deg ACQ TIME=14.67 min
FILE: f32c3 Carneiro - Ti alloy cast HS
SCALE FACTOR= 0.682 k c/s, OFFSET= 0.005 k c/s PASS ENERGY= 44.750 eV A1 300 W



Ti6Al4V cast control sample before and after RFGDT

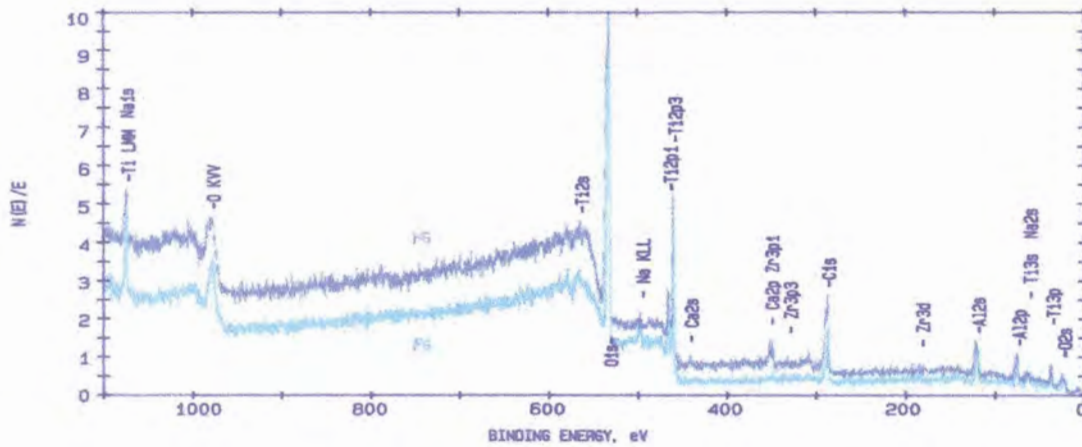


ESCA SURVEY 4/10/91 ANGLE= 65 deg ACQ TIME=9.17 min
FILE: f27A1 Carneiro - Ti Alloy machined CS
SCALE FACTOR= 1.436 k c/s, OFFSET= 0.000 k c/s PASS ENERGY= 44.750 eV A1 300 W



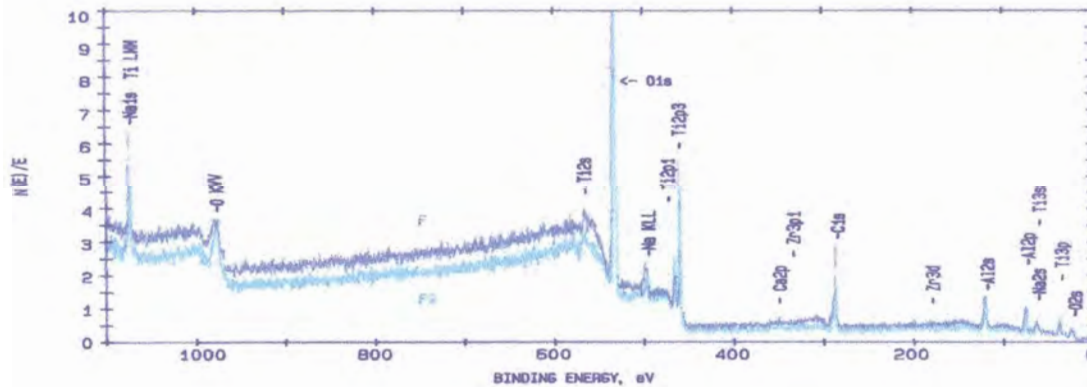
cpTi and Ti6Al4V machined control samples after RFGDT

ESCA SURVEY 4/15/91 ANGLE= 65 deg ACQ TIME=9.17 min
FILE: f32C1 Carneiro - Ti alloy cast HG
SCALE FACTOR= 0.648 k c/s, OFFSET= 0.000 k c/s PASS ENERGY= 44.750 eV A1 300 W



cpTi and Ti6Al4V cast control samples after RFGDT

ESCA SURVEY 4/10/91 ANGLE= 65 deg ACQ TIME=9.17 min
FILE: f27I1 Carneiro - Ti F
SCALE FACTOR= 0.759 k c/s, OFFSET= 0.004 k c/s PASS ENERGY= 44.750 eV A1 300 W



cpTi cast control sample before and after RFGDT

SURFACE TOPOGRAPHY OF MACHINED AND CAST TITANIUM AND TITANIUM ALLOYS USED IN DENTISTRY.

L.C. Carneiro, S.J. Botha, P.L. Kemp* and T. von Moltke**

Centre for Stomatological Research, *Department of Prosthetics, School of Dentistry and **Department of Material Science and Metallurgical Engineering, University of Pretoria.

Surface roughness of prefabricated titanium implants has been reported to alter the phenotypic expression of cells. Therefore, preparation of these surfaces and cleaning procedures adopted for implants should aim at maintaining the elemental composition without modifying surface topography. With the introduction of cast titanium, an alternative method of implant fabrication was developed, but little is known of the surface characteristics of these cast metals.

This study aimed to determine and compare the surface topography of cast and machined titanium surfaces manufactured from both pure titanium and titanium alloy as well as the effect of Radio Frequency Glow Discharge (RFGD) treatment on surface topography of these materials.

Circular machined and cast discs of 6.35mm diameter and 2mm thick were fabricated in duplicate from titanium (Grade 3) and titanium alloys (Grade 5 and 23). One sample from each group was RFGD treated and the other served as control. Surface topography was determined using the Atomic Force Microscope (Topometrix TMX 2010 Discoverer). On each sample five scans were performed of range of 20µm and 5µm. Data from the different scans were compared and specific properties of the surface topography were calculated.

Results show that for both scanned areas the average R_a value for cast samples was higher compared to the machined surfaces thereby confirming that the cast samples had a larger surface area than the machined surfaces. Similarly, other results (RMS and average height) were higher for cast samples. For both scan ranges no differences were noted between results for neither the titanium and titanium alloys nor for samples that were radio frequency glow discharged treated. The averages of the line analysis of the different measurements for the different scans done also show that cast samples are rougher than machined samples. R_m values indicate a consistent surface finish for machined and cast surfaces; 237-314µm and 870-1020µm respectively. The cast surfaces had a very high R_t value as compared to machined surfaces (2000µm vs 600µm) indicating a very large difference between the highest and lowest peak for the cast samples. The low R_{pm} as compared to the high R_m indicates a plateau surface seen in both the machined and cast samples.

It can be concluded that the method of fabrication determined the surface topography. Furthermore, RFGD treatment did not significantly modify the surface topography of these materials. The surface roughness of cast samples was probably related to the method of investment removal.

Table 1: Average values of secondary surface topography obtained from a 20µm scan.

	Ti, mach	Ti, mach, RFGD	Ti-alloy, mach	Ti -alloy, mach, RFGD	Ti, cast	Ti, cast, RFGD	Ti-alloy, cast	Ti-alloy, cast, RFGD
Average of R_a (µm)	0.140	0.098	0.088	0.144	0.520	0.647	0.450	0.412
Average area of RMS (µm)	0.172	0.127	0.110	0.182	0.654	0.792	0.554	0.522
Average surface area (µm ²)	416.180	416.340	415.000	425.020	531.920	559.140	508.260	535.260
Average height (µm)	0.585	0.439	0.635	0.532	1.882	2.209	1.741	1.922

Table 2: Average values of primary surface topography obtained from a 5µm scan.

	Ti, mach	Ti, mach, RFGD	Ti-alloy, mach	Ti -alloy, mach, RFGD	Ti, cast	Ti, cast, RFGD	Ti-alloy, cast	Ti-alloy, cast, RFGD
Average of R_a (µm)	0.060	0.070	0.080	0.110	0.260	0.270	0.090	0.200
Average area of RMS (µm)	0.070	0.080	0.100	0.130	0.320	0.340	0.310	0.250
Average surface area (µm ²)	27.280	26.560	27.980	28.00	32.860	34.270	34.940	32.390
Average height (µm)	0.270	0.220	0.350	0.310	0.680	0.800	0.750	0.580

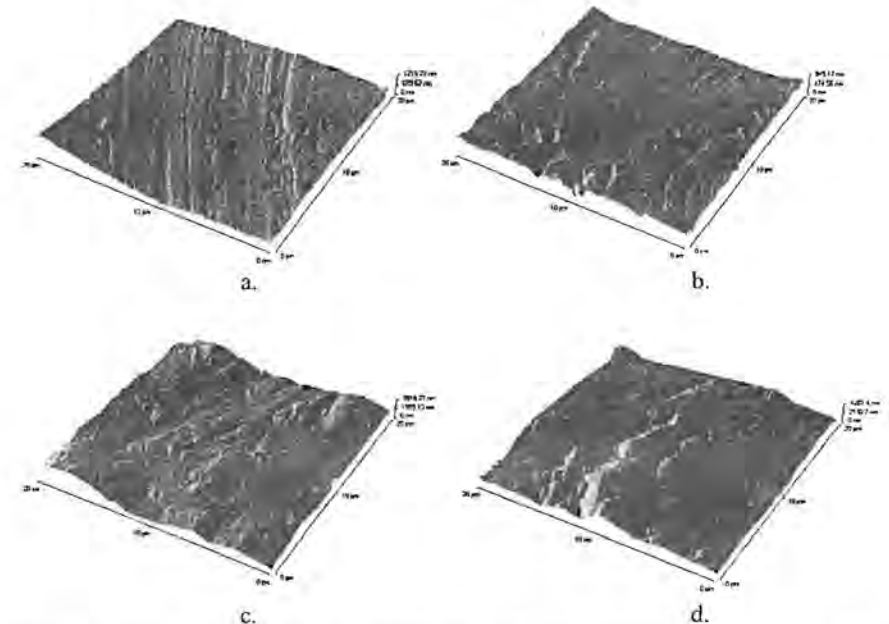


Figure 1: AFM 20µm scans of: a.) Pure Ti, machined sample; b.) Ti-alloy, machined sample; c.) Pure Ti, cast sample; d.) Ti-alloy, cast sample.

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X-RAY SPECTROSCOPY OF DIFFERENTLY CHARACTERISED MACHINED AND CAST TITANIUM AND TITANIUM ALLOYS.

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Surface contaminants are inherently related to the surface preparation procedures that are used when manufacturing implants. The outermost atomic layer of the implant surface is a key factor in bio-acceptability. Radio Frequency Glow Discharge (RFGD) treatment has been promoted as a method for cleaning, as well as sterilizing metal surfaces for biological use. The aim of this study was to analyze the chemical composition after RFGD treatment on differently characterized machined and cast Titanium (Ti) and Titanium alloy (Ti-alloy) surfaces.

Circular discs of 6.35mm diameter and 2mm thick were fabricated from Titanium (Grade 3) and Titanium alloy (Grade 5) by machining and casting. The samples were characterized by blasting with 250µm or 110µm Aluminium-Oxide particles and acid etching (enhanced). The control group was not blasted with Aluminium-Oxide or acid etched. RFGD treatment was performed on the surface of one of the samples in each group while the others were analyzed as only enhanced samples. The chemical composition was determined using a Perkin-Elmer – PHI 5400 X-ray photoelectron spectrometer.

Results of the average values of elemental chemical composition is given in Table 1. It is evident that RFGD treatment removed the impurities – Zn, Pb, N and V. Pure Ti, machined samples, that were not enhanced had no Al, but a significant concentration of Al ranging from 1-15 percent was detected on all the other machined, cast and enhanced surfaces. Machined pure Ti and Ti-alloy that were RFGD treated, showed no Ca on the surface, but Ca (0.06-1.03%) was found on all other surfaces that were analyzed. Sodium was found on all the cast samples and is probably introduced to the surface by the technical process of cast sample preparation. RFGD significantly reduced C concentrations on the surface and therefore increased the O and Ti elemental concentrations. This may be advantageous for the formation of optimal TiO or TiO₂ surfaces that promote bio-acceptability and osseo-intergration.

Although RFGD treatment can be promoted as a method of preparing metallic surfaces for biological and clinical application, especially because of the increase in elemental Ti and O on the surface, its use in the removal of Al introduced by surface characterization is apparently restricted. Furthermore, acid etching did not influence the Al content probably because the Aluminium oxide particles were embedded onto the surface. If it is found that bio-acceptability is restricted then further investigation is required to facilitate elimination of the Al surface that was introduced by Aluminium-Oxide sandblasting and the Na that was introduced by cast sample preparation techniques.

Table 1: Elemental composition in Atomic Percent of the differently prepared surfaces of pure Titanium and Titanium-alloy as determined with X-ray photoelectron spectroscopy.

Element	C	O	Ti	Zn	Pb	Na	Ca	N	V	Zr	Al
Ti, machined	37.7	45.8	11.2	2.7	0.5		0.6	1.4			
Ti, machined, RFGD	20.8	56.4	21.6					0.8		0.4	
Ti, machined, enh 110µm	41.5	43.6	7.2	0.5			0.4				5.2
Ti, machined, enh 110µm, RFGD	19.9	52.7	12.9				0.3				9.7
Ti, machined, enh 250µm	29.5	51.4	8.8	1.4			0.9				5.8
Ti, machined, enh 250µm, RFGD	15.1	55.9	14.7				0.4				7.5
Ti-alloy, machined	36.8	48.7	10.3	2.1	0.4		0.3	0.5	0.9		1.0
Ti-alloy, machined, RFGD	21.8	56.7	18.8							0.7	1.2
Ti-alloy, machined, enh 110µm	36.7	43.8	4.2			5.9	0.2	0.5			8.7
Ti-alloy, machined, enh 110µm, RFGD	14.9	55.3	12.9	0.2		6.2	0.3			0.4	9.8
Ti-alloy, machined, enh 250µm	29.2	52.2	5.5	0.7			0.8				9.5
Ti-alloy, machined, enh 250µm, RFGD	16.1	55.5	13.7				0.3				9.2
Ti, cast	23.6	53.6	5.3			4.6	0.2				12.7
Ti, cast, RFGD	15.1	57.9	9.2			4.7	0.4			0.2	12.9
Ti, cast, enh 110µm	37.3	43.9	4.3	0.2		2.2	0.5	1.1			10.5
Ti, cast, enh 110µm, RFGD	15.5	56.3	14.6			4.5	0.4			0.5	8.2
Ti, cast, enh 250µm	25.6	52.9	7.1	0.7		3.3	0.5				9.8
Ti, cast, enh 250µm, RFGD	23.1	51.3	12.9			3.0	0.5	0.9		0.3	7.9
Ti-alloy, cast	28.7	51.4	5.6			3.3	0.4	0.8	0.2		9.6
Ti-alloy, cast, RFGD	25.3	55.4	6.2			1.5	1.0			0.1	10.5
Ti-alloy, cast, enh 110µm	32.7	47.7	8.4	0.1		2.2	0.2	0.7			8.0
Ti-alloy, cast, enh 110µm, RFGD	14.9	55.5	9.9			3.5	0.1			0.4	15.1
Ti-alloy, cast, enh 250µm	28.9	52.2	4.8	0.5		2.4	0.6	0.4			10.1
Ti-alloy, cast, enh 250µm, RFGD	15.9	56.6	12.6			3.2	0.4			0.4	10.9

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