CORROSION FIGURES FOR COPPER ALLOYS EXPOSED TO UF_6 GAS AT 15 kPa

TABLE 4.1.8 : MUNTZ METAL

Temperature ^{o}C	Exposure Time t, h	Mass Increase Δm, $\mu g\ cm^{-2}$
50	5	19
	18	79
	48	58
	149	248
	984	340
80	5	39
	23	31
	42	317
	188	580
	1026	1123
100	5	46
	20	79
	41	372
	163	618
	979	802
120	3	80
	21	278
	43	709
	187	1131
	1005	1663
150	5	181
	16	1268
	41	1443
	209	4080
	1006	7359

CORROSION FIGURES FOR COPPER ALLOYS EXPOSED TO UF_6 GAS AT 15 kPa

TABLE 4.1.9 : 50 Cu 50 Zn

Temperature ^{o}C	Exposure Time t, h	Mass Increase Δm, $\mu g\ cm^{-2}$
50	6	13
	24	18
	46	22
	213	43
	980	117
80	6	19
	24	73
	46	98
	213	223
	980	798
100	6	111
	24	113
	46	156
	213	348
	980	1437
120	6	173
	24	220
	46	343
	213	1062
	980	1713
150	6	497
	24	389
	46	728
	213	3153
	980	6279

CORROSION FIGURES FOR COPPER ALLOYS EXPOSED TO UF_6 GAS AT 15 kPa

TABLE 4.1.10 : 25 Cu 75 Zn

Temperature ^{o}C	Exposure Time t, h	Mass Increase Δm, $\mu g\ cm^{-2}$
50	6	23
	24	27
	46	28
	213	43
	980	236
80	6	27
	24	231
	46	425
	213	778
	980	1176
100	6	15
	24	148
	46	205
	213	309
	980	1839
120	6	168
	24	302
	46	579
	213	1396
	980	1873
150	6	462
	24	578
	46	1441
	213	2162
	980	4140

CORROSION FIGURES FOR COPPER ALLOYS EXPOSED TO UF_6 GAS AT 15 kPa

TABLE 4.1.11 : 10 Cu 90 Zn

Temperature ^{o}C	Exposure Time t, h	Mass Increase Δm, $\mu g\ cm^{-2}$
50	6	6
	24	15
	46	24
	213	38
	980	342
80	6	10
	24	141
	46	422
	213	532
100	6	15
	24	351
	213	1647
	980	2142
120	6	43
	24	66
	46	1467
	980	2366
150	6	227
	24	464
	46	1279
	213	2440
	980	4362

CORROSION FIGURES FOR COPPER ALLOYS EXPOSED TO UF_6 GAS AT 15 kPa

TABLE 4.1.12 : ADMIRALTY BRASS

Temperature ^{o}C	Exposure Time t, h	Mass Increase Δm, $\mu g\ cm^{-2}$
50	6	23
	24	37
	46	49
	213	62
	980	204
30	6	46
	24	98
	46	143
	213	827
	980	1353
100	6	88
	24	200
	46	276
	213	583
	980	2835
120	6	196
	24	345
	46	442
	213	783
	980	2163
150	6	264
	24	927
	46	1388
	213	3864
	980	7825

CORROSION FIGURES FOR COPPER ALLOYS EXPOSED TO UF_6 GAS AT 15 kPa

TABLE 4.1.13 : NAVAL BRASS

Temperature ^{o}C	Exposure Time t, h	Mass Increase Δm, $\mu g\ cm^{-2}$
50	5	34
	18	140
	48	124
	185	335
	984	562
80	5	58
	23	36
	42	411
	188	957
	1026	2050
100	5	256
	20	257
	41	602
	163	1291
	979	2878
120	3	204
	21	791
	43	956
	187	2448
	1005	5343
150	5	523
	16	1961
	41	4193
	209	5799
	1006	16098

CORROSION FIGURES FOR COPPER ALLOYS EXPOSED TO UF_6 GAS AT 15 kPa

TABLE 4.1.14 : LEADED BRASS

Temperature ^oC	Exposure Time t, h	Mass Increase Δm, $\mu g\ cm^{-2}$
50	6	19
	24	21
	46	70
	213	126
	980	196
80	6	8
	24	79
	46	148
	213	285
	980	2095
100	6	16
	24	111
	46	131
	213	252
	980	1865
120	6	87
	24	274
	46	717
	213	1162
	980	2725
150	6	188
	24	573
	46	1688
	213	3552
	980	7215

CORROSION FIGURES FOR COPPER ALLOYS EXPOSED TO UF_6 GAS AT 15 kPa

TABLE 4.1.15 : 95/5 PHOSPHOR BRONZE

Temperature °C	Exposure Time t, h	Mass Increase Δm, $\mu g\ cm^{-2}$
50	5	13
	18	6
	48	23
	185	54
	984	71
80	5	35
	23	43
	42	79
	188	155
	1026	223
100	5	65
	20	44
	41	68
	163	208
	979	281
120	3	61
	21	86
	43	173
	187	260
	1005	480
150	5	176
	16	310
	41	473
	209	772
	1006	1737

CORROSION FIGURES FOR COPPER ALLOYS EXPOSED TO UF_6 GAS AT 15 kPa

TABLE 4.1.16 : 90/10 PHOSPHOR BRONZE

Temperature ^{o}C	Exposure Time t, h	Mass Increase Δm, $\mu g\ cm^{-2}$
50	6	14
	24	49
	46	65
	213	253
	980	585
80	6	18
	24	141
	46	175
	213	730
	980	1589
10[illegible]	6	52
	24	184
	46	290
	213	746
	980	1402
120	6	78
	24	227
	46	427
	213	1131
	980	[illegible]348
150	6	235
	24	369
	46	996
	213	3841
	980	7404

CORROSION FIGURES FOR COPPER ALLOYS EXPOSED TO UF_6 GAS AT 15 kPa

TABLE 4.1.17 : BERYLLIUM COPPER

Temperature °C	Exposure Time t, h	Mass Increase Δm, $\mu g\ cm^{-2}$
30	5	6
	18	6
	48	8
	185	18
	984	20
80	5	27
	23	28
	42	33
	188	57
	1026	96
120	5	37
	20	20
	41	15
	163	69
	979	279
150	5	56
	21	57
	45	88
	187	355
	1005	565
250	5	151
	16	283
	41	484
	209	755
	1006	1200

CORROSION FIGURES FOR COPPER ALLOYS EXPOSED TO UF_6 GAS AT 15 kPa

TABLE 4.1.17 : BERYLLIUM COPPER

Temperature °C	Exposure Time t, h	Mass Increase Δm, $\mu g\ cm^{-2}$
50	5	6
	18	6
	48	9
	185	18
	984	20
80	5	21
	23	28
	42	33
	188	37
	1026	95
100	5	37
	20	20
	41	13
	163	69
	979	279
120	3	56
	21	57
	43	84
	187	355
	1005	563
150	5	121
	16	285
	41	484
	209	735
	1006	1369

CORROSION FIGURES FOR COPPER ALLOYS EXPOSED TO UF_6 GAS AT 15 kPa

TABLE 4.1.18 : 18 % NICKEL SILVER

Temperature ^{o}C	Exposure Time t, h	Mass Increase Δm, $\mu g\ cm^{-2}$
50	5	18
	18	27
	48	36
	185	62
	984	105
80	5	38
	23	56
	42	110
	188	241
	1026	434
100	5	93
	20	58
	41	145
	163	241
	979	488
120	3	156
	21	166
	43	174
	187	537
	1005	766
150	5	256
	16	475
	41	618
	209	1008
	1006	2783

CORROSION FIGURES FOR COPPER ALLOYS EXPOSED TO UF_6 GAS AT 15 kPa

TABLE 4.1.19 : ALUMINIUM BRONZE

Temperature ^{o}C	Exposure Time t, h	Mass Increase Δm, $\mu g\ cm^{-2}$
50	5	4
	21	20
	118	20
	190	20
	501	23
	981	30
80	5	21
	21	26
	118	37
	90	84
	501	96
	981	113
100	5	20
	21	34
	118	127
	190	150
	501	227
	981	331
120	5	21
	21	106
	118	186
	190	257
	501	365
	981	602
150	5	94
	21	147
	118	458
	190	578
	501	1130
	981	1546

TABLE 4.2 : VALUES OF THE CONSTANTS A AND n RESULTING FROM EMPIRICALLY FITTING CORROSION DATA TO $\Delta m = At^n$

Alloy	Temperature ^oC	A	n
Electrolytic Copper	50	15,57	0,16
	80	17,95	0,37
	100	20,50	0,38
	120	68,05	0,18
	150	109,82	0,37
95/5 Brass	50	17,67	0,18
	80	16,24	0,39
	100	22,64	0,39
	120	41,63	0,36
	150	130,61	0,37
90/10 Brass	50	13,54	0,31
	80	20,07	0,45
	100	32,12	0,42
	120	58,61	0,40
	150	178,16	0,41
85/15 Brass	50	7,80	0,47
	80	25,07	0,51
	100	37,42	0,51
	120	107,62	0,40
	150	228,05	0,44

TABLE 4.2 : VALUES OF THE CONSTANTS A AND n RESULTING FROM EMPIRICALLY FITTING CORROSION DATA TO $\Delta m = At^n$
(Continued)

Alloy	Temperature °C	A	n
80/20 Brass	50	24,89	0,37
	80	33,34	0,52
	100	71,77	0,45
	120	168,16	0,37
	150	351,22	0,40
70/30 Brass	50	8,38	0,55
	80	49,26	0,47
	100	65,67	0,46
	120	123,16	0,41
	150	303,52	0,43
70/30 Brass (Commercial alloy)	50	30,64	0,38
	80	35,23	0,49
	100	71,68	0,44
	120	164,52	0,37
	150	293,89	0,44
Muntz metal	50	25,34	0,38
	80	39,28	0,49
	100	81,64	0,34
	120	162,85	0,34
	150	313,42	0,46

TABLE 4.2 : VALUES OF THE CONSTANTS A AND n RESULTING FROM EMPIRICALLY FITTING CORROSION DATA TO $\Delta m = At^n$
(Continued)

Alloy	Temperature ^oC	A	n
50 Cu 50 Zn	50	2,48	0,56
	80	4,20	0,76
	100	4,88	0,82
	120	75,75	0,46
	150	121,79	0,57
25 Cu 75 Zn	50	0,46	0,90
	80	50,00	0,47
	100	1,70	1,01
	120	42,00	0,57
	150	227,06	0,42
10 Cu 90 Zn	50	0,04	1,33
	80	45.02	0,47
	100	146,95	0,40
	120	172,52	0 38
	150	185,99	0,46
Admiralty Brass	50	4,52	0,55
	80	35,00	0,54
	100	4,59	0,93
	120	46,53	0,56
	150	196,87	0,54

TABLE 4.2 : VALUES OF THE CONSTANTS A AND n RESULTING FROM EMPIRICALLY FITTING CORROSION DATA TO $\Delta m = At^n$
(Continued)

Alloy	Temperature ^oC	A	n
Naval Brass	50	34,52	0,41
	80	46,11	0,55
	100	94,98	0,50
	120	165,11	0,50
	150	398,50	0,53
Leaded Brass	50	12,42	0,41
	80	0,47	1,22
	100	0,46	1,21
	120	68,63	0,53
	150	191,54	0,53
95/5 Phosphor Bronze	50	6,33	0,36
	80	21,88	0,34
	100	26,80	0,35
	120	37,15	0,37
	150	82,09	0,44
90/10 Phosphor Bronze	50	7,90	0,63
	80	24,08	0,61
	100	45,40	0,50
	120	46,64	0,58
	150	144,31	0,57

TABLE 4.2 : VALUES OF THE CONSTANTS A AND n RESULTING FROM EMPIRICALLY FITTING CORROSION DATA TO $\Delta m = At^n$
(Continued)

Alloy	Temperature °C	A	n
Beryllium Copper	50	3,53	0,26
	80	7,89	0,35
	100	1,40	0,77
	120	25,30	0,45
	150	101,55	0,38
18 % Nickel Silver	50	10,27	0,34
	80	21,55	0,44
	100	29,99	0,40
	120	70,87	0,35
	150	80,21	0,51
Aluminium Bronze	50	4,08	0,31
	80	10,33	0,35
	100	7,71	0,55
	120	11,53	0.58
	150	32,99	0,55

TABLE 4.3 : X-RAY DIFFRACTION RESULTS FOR VARIOUS COPPER ALLOYS EXPOSED TO UF_6 GAS AT 15 kPa

Alloy	Corrosion Conditions		Uranium Fluorides identified
	Time h	Temperature ^oC	
Electrolytic Copper	250	120	β-UF_5
Electrolytic Copper	282	80	β-UF_5
Electrolytic Copper	264	100	β-UF_5
90/10 Brass	250	120	β-UF_5
90/10 Brass	282	100	β-UF_5
90/10 Brass	264	80	β-UF_5
90/10 Brass	1006	150	U_2F_9
70/30 Brass	209	150	U_2F_9
70/30 Brass	16	150	U_2F_9
70/30 Brass	1006	100	U_2F_9
70/30 Brass	1006	80	U_2F_9
Leaded Brass	262	100	β-UF_5, U_2F_9
95/5 Phosphor Bronze	282	100	β-UF_5, U_2F_9
Beryllium Copper	250	120	β-UF_5
Beryllium Copper	282	100	β-UF_5
Beryllium Copper	264	80	β-UF_5
18 % Nickel Silver	250	120	β-UF_5, U_2F_9

TABLE 4.4 : X-RAY DIFFRACTION RESULTS OF THE TEMPERATURE-CHANGE EXPERIMENT. UF_6 PRESSURE : 15 kPa. (50) SIGNIFIES PRE-FLUORINATION AT 50 °C FOR 140 h. TOTAL TIME AT INITIAL TEMPERATURE (S) : 600 h. TIME AT FINAL TEMPERATURE 840 h

Alloy	Initial Temperature °C	Final Temperature °C	Uranium Fluorides Identified
Electrolytic Copper	80	150	α-UF_5 + β-UF_5
95/5 Brass	(50) 150	80	U_2F_9 + α-UF_5 + β-UF_5
80/20 Brass	(50) 150	80	U_2F_9 + α-UF_5
70/30 Brass	(50) 150	80	U_2F_9 + α-UF_5
Muntz metal	80	150	U_2F_9 + α-UF_5
Leaded Brass	(50) 150	80	U_2F_9 + α-UF_5

TABLE 4.5: ACTIVATION ENERGIES FOR THE CORROSION OF Cu-Zn ALLOYS EXPOSED TO UF_6 GAS AT 15 kPa

Alloy	Temperature Range	Activation Energy Q kJ mol $^{-1}$
Cu 5 Zn	50 - 120 ^{o}C	22,8
Cu 5 Zn	120 - 150 ^{o}C	54,0
Cu 10 Zn	50 - 120 ^{o}C	25,4
Cu 10 Zn	120 - 150 ^{o}C	52,7
Cu 20 Zn	50 - 80 ^{o}C	20,2
Cu 20 Zn	80 - 150 ^{o}C	37,3
Cu 30 Zn (Comm. alloy)	50 - 80 ^{o}C	12,8
Cu 30 Zn (Comm. alloy)	80 - 150 ^{o}C	35,9

TABLE 4.6 : RESULTS OF TEMPERATURE-CHANGE EXPERIMENT. TEMPERATURE WAS MAINTAINED AT 50 °C FOR 140 h, AT 150 °C FOR 460 h AND AT 80 °C FOR A FURTHER 840 h.

Time t, h	Temp. °C	Mass increase, Δm (μg cm^{-2})								
		Cu 5 Zn	Cu 10 Zn	Cu 15 Zn	Cu 20 Zn	Cu 30 Zn	Leaded Brass	95/5 Phosphor Bronze	BeCu	Naval Brass
120	50	65	38	52	20	11	97	216	21	91
140	50	73	49	65	47	133	155	246	25	99
168	150	426	98	365	499	60[illegible]	593	606	[illegible]67	812
336	150	636	293	712	893	1034	1001	915	519	2037
504	150	734	380	815	1118	1193	1145	922	601	2579
600	150	696	512	811	1097	1234	1209	990	626	2814
672	80	762	521	824	1154	1317	1210	1006	628	2814
840	80	747	452	836	1105	1244	1247	993	632	2862
1008	80	733	432	832	1126	1204	1143	1044	631	2819
1176	80	713	519	802	1044	1207	1129	1009	605	2924
1440	80	738	431	842	1162	1230	1106	1031	613	2922

TABLE 4.7 : RESULTS OF TEMPERATURE-CHANGE EXPERIMENT. THE TEMPERATURE WAS HELD AT 80 °C FOR 600 h AND THEN INCREASED TO 150 °C FOR 840 h.

Time t,h	Temp. °C	Mass Increase Δm (μg cm^{-2})			
		Electrolytic Copper	Cu 30 Zn (Comm. alloy)	Muntz metal	18 % Nickel Silver
120	80	75	170	261	106
144	80	110	212	285	116
168	80	145	256	298	129
336	80	203	296	397	211
504	80	265	399	512	207
600	80	294	455	601	320
768	150	394	708	901	502
840	150	479	946	1091	659
1008	150	648	1312	1544	910
1176	150	786	1549	1827	962
1440	150	869	1785	2213	1258

TABLE 4.8 : APPARENT ACTIVATION ENERGIES FOR THE TEMPERATURE RANGE 80 - 150 ^{o}C AS OBTAINED FROM THE TEMPERATURE-CHANGE EXPERIMENTS

Alloy	Apparent activation energy, Q (kJ mol $^{-1}$)
Electrolytic Copper	5,9
70 Cu 30 Zn (Comm. alloy)	13,0
Muntz metal	11,6

TABLE 4.9 : CORROSION FIGURES FOR COPPER ALLOYS AIR-OXIDIZED AT 150 °C FOR 15 MINUTES AND EXPOSED TO UF_6 GAS AT 15 kPa

TABLE 4.9.1 : 95/5 BRASS

Temperature °C	Exposure Time t, h	Mass Increase Δm, $\mu g\ cm^{-2}$
100	94	80
	262	152
	484	304
	768	480
120	94	150
	262	331
	484	551
	768	780
150	94	658
	262	890
	484	1100
	768	1325

CORROSION FIGURES FOR COPPER ALLOYS AIR-OXIDIZED AT 150 ^{o}C FOR 15 MINUTES AND EXPOSED TO UF_6 GAS AT 15 kPa

TABLE 4.9.2 : 85/15 BRASS

Temperature ^{o}C	Exposure Time t, h	Mass Increase Δm, $\mu g\ cm^{-2}$
100	94	94
	262	287
	484	480
	768	760
120	94	320
	262	781
	484	1310
	768	1886
150	94	803
	262	1836
	484	3006
	768	4200

CORROSION FIGURES FOR COPPER ALLOYS AIR-OXIDIZED AT 150 °C FOR 15 MINUTES AND EXPOSED TO UF_6 GAS AT 15 kPa

TABLE 4.9.3 : 80/20 BRASS

Temperature °C	Exposure Time t, h	Mass Increase Δm, $\mu g\ cm^{-2}$
100	94	110
	262	250
	484	441
	768	639
120	94	195
	262	420
	484	654
	768	932
150	94	2091
	262	3531
	484	4795
	768	6405

CORROSION FIGURES FOR COPPER ALLOYS AIR-OXIDIZED AT 150 °C FOR 15 MINUTES AND EXPOSED TO UF_6 GAS AT 15 kPa

TABLE 4.9.4 : 70/30 BRASS

Temperature °C	Exposure Time t, h	Mass Increase Δm, $\mu g\ cm^{-2}$
100	94	93
	262	166
	484	259
	768	351
120	94	212
	262	441
	484	680
	768	961
150	94	1976
	262	3528
	484	5024
	768	6613

CORROSION FIGURES FOR COPPER ALLOYS AIR-OXIDIZED AT 150 °C FOR 15 MINUTES AND EXPOSED TO UF_6 GAS AT 15 kPa

TABLE 4.9.5 : MUNTZ METAL

Temperature °C	Exposure Time t, h	Mass Increase Δm, $\mu g\ cm^{-2}$
100	94	88
	262	203
	484	365
	768	538
120	94	238
	262	467
	484	715
	768	971
150	94	1424
	262	2160
	484	3180
	768	4102

CORROSION FIGURES FOR COPPER ALLOYS AIR-OXIDIZED AT 150 °C FOR 15 MINUTES AND EXPOSED TO UF_6 GAS AT 15 kPa

TABLE 4.9.6 : ELECTROLYTIC COPPER

Temperature °C	Exposure Time t, h	Mass Increase Δm, $\mu g\ cm^{-2}$
100	94	50
	262	99
	484	160
	768	213
120	94	116
	262	238
	484	361
	768	511
150	94	208
	262	415
	484	592
	768	882

TABLE 4.10 : VALUES OF THE CONSTANTS A AND n FOR PRE-OXIDIZED ALLOYS RESULTING FROM EMPIRICALLY FITTING CORROSION DATA TO $\Delta m = At^n$

Alloy	Temperature ^oC	A	n
Electrolytic Copper	100	2,09	0,70
	120	4,76	0,70
	150	9,66	0,67
95/5 Brass	100	1,50	0,86
	120	4,16	0,79
	150	144,82	0,33
85/15 Brass	100	1,09	0,99
	120	6,88	0,85
	150	22,18	0,79
80/20 Brass	100	2,36	0,84
	120	6,69	0,74
	150	189,45	0,53
70/30 Brass	100	5,08	0,63
	120	8,13	0,72
	150	145,06	0,57
Muntz Metal	100	1,69	0,87
	120	11,26	0,67
	150	137,95	0,51

TABLE 4.11 : ACTIVATION ENERGIES FOR THE CORROSION OF PRE-OXIDIZED Cu-Zn ALLOYS IN UF_6 GAS AT 15 kPa IN THE TEMPERATURE RANGE 100 - 150 ^{o}C

Alloy	Activation Energy Q, kJ mol^{-1}
Electrolytic Copper	38
Cu 5 Zn	97
Cu 15 Zn	71
Cu 20 Zn	103
Cu 30 Zn	86
Cu 40 Zn	109

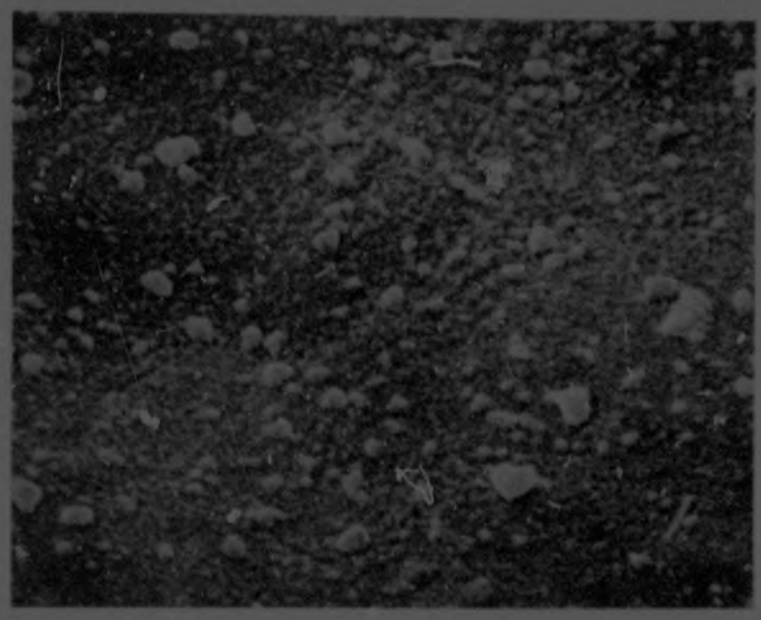

FIGURE 4.1 : β-UF_5 CRYSTALS ON ELECTROLYTIC COPPER AFTER 200 h EXPOSURE TO UF_6 AT 80 ^{o}C (x 2000)

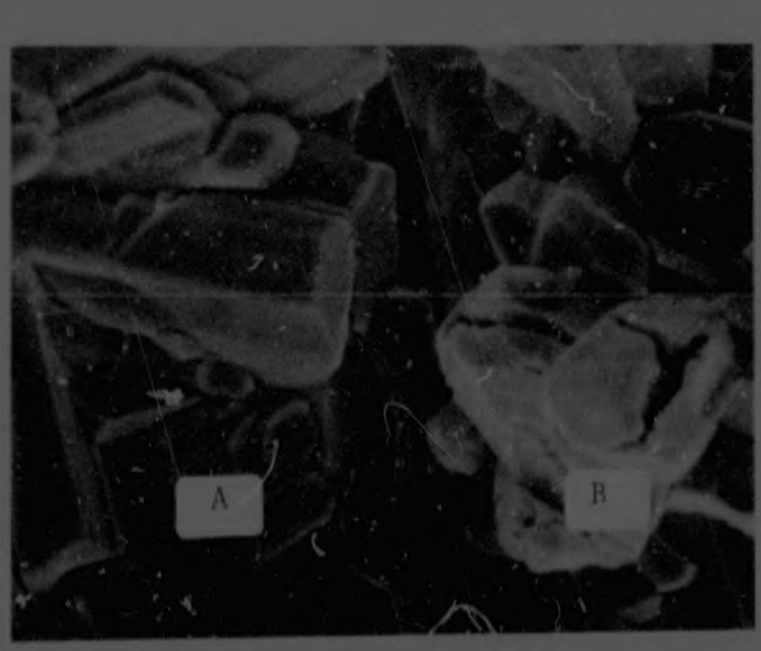

FIGURE 4.2 : U_2F_9 CRYSTALS (A) ON 70/30 BRASS BRASS AFTER 1000 h EXPOSURE TO UF_6 AT 150 ^{o}C (x 3000) (SOME CRYSTALS (B) CRACKED DUE TO REACTION WITH MOISTURE LEADING TO AN AMORPHOUS MIXTURE OF UF_4 AND UO_2F_2)

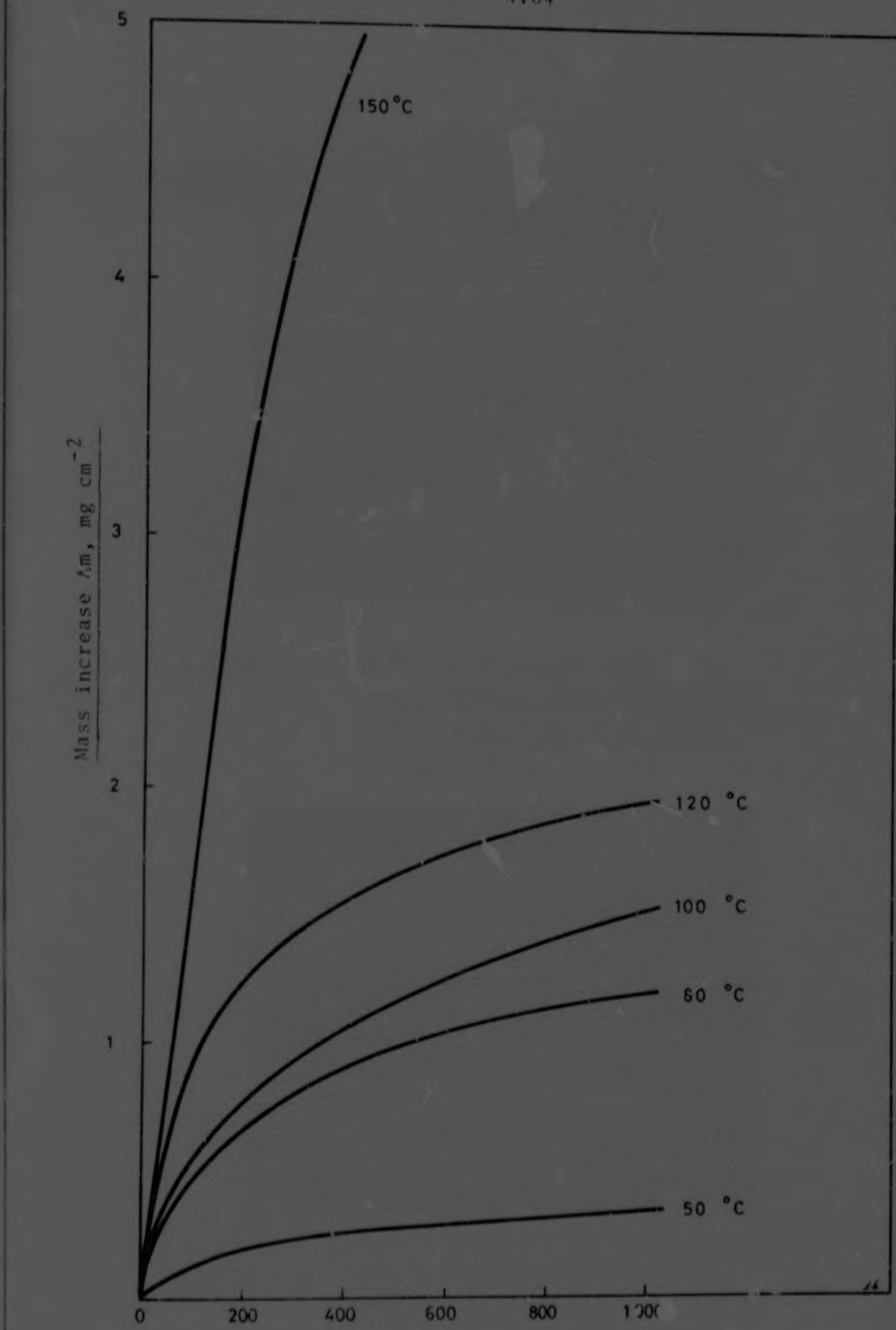

FIGURE 4.3 : CORROSION OF 70/30 BRASS IN UF_6 GAS AT 15 kPa AS A FUNCTION OF TEMPERATURE

FIGURE 4.4 : SECTION OF 80/20 α-BRASS SPECIMEN SHOWING FLUORIDE PENETRATION. EXPOSED TO UF_6 GAS AT 15 kPa AT 150 °C FOR 1 000 h (x 900)

FIGURE 4.5 : SECTION OF 85/15 α-BRASS SPECIMEN SHOWING FLUORIDE PENETRATION. EXPOSED TO UF_6 GAS AT 15 kPa AT 150 °C FOR 1 000 h (x 900)

FIGURE 4.6 : SECTION OF A LEADED BRASS SPECIMEN SHOWING FLUORIDE PENETRATION AND VOID FORMATION. EXPOSED TO UF_6 GAS AT 15 kPa AT 150 ^{o}C FOR 930 h (x 10 000)

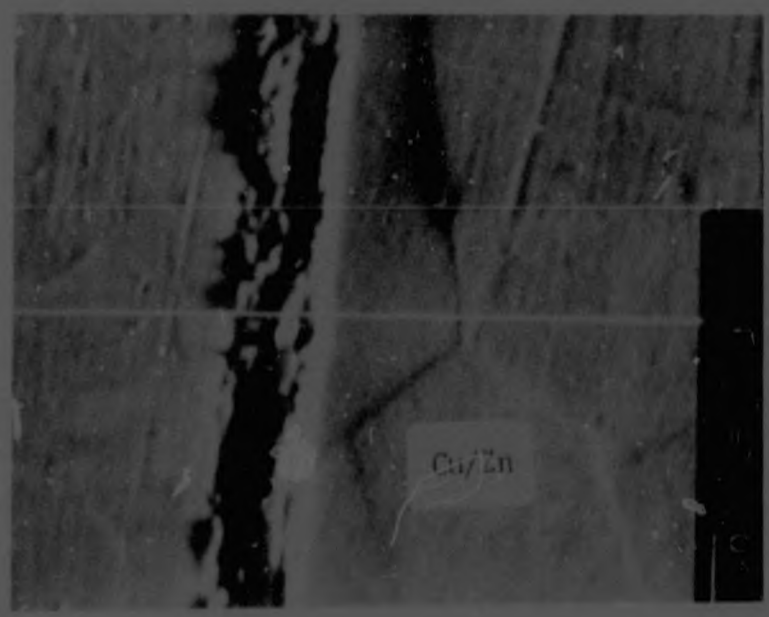

FIGURE 4.7 : SECONDARY ELECTRON IMAGE OF 70/30 BRASS SPECIMEN AFTER 1000 h EXPOSURE TO UF_6 AT 150 ^{o}C. AUGER TRACES SHOWN IN FIGURE 4.8 WERE OBTAINED ALONG THE LINE SHOWN (x 1170)

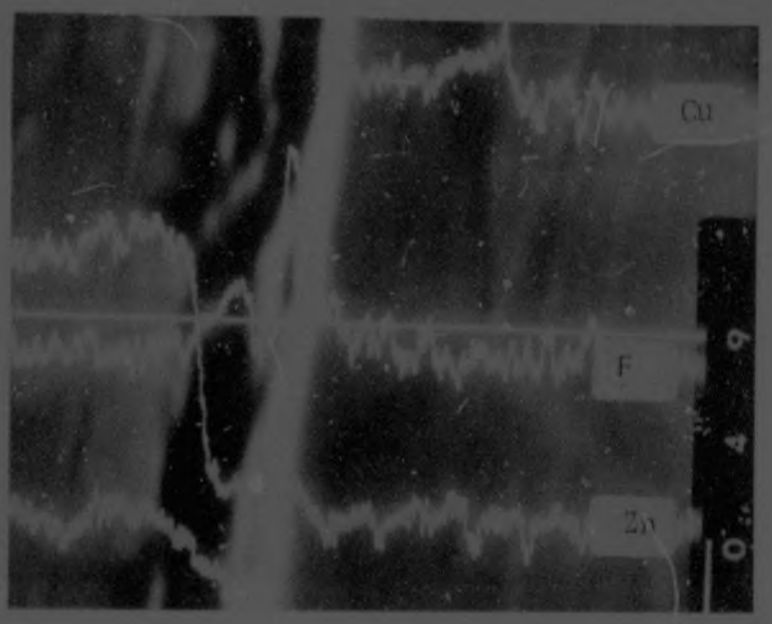

FIGURE 4.8 : (REFER FIGURE 4.7). AUGER LINE ANALYSIS FOR THE ELEMENTS Cu, F AND Zn ACROSS PENETRATION ZONE (x 1170)

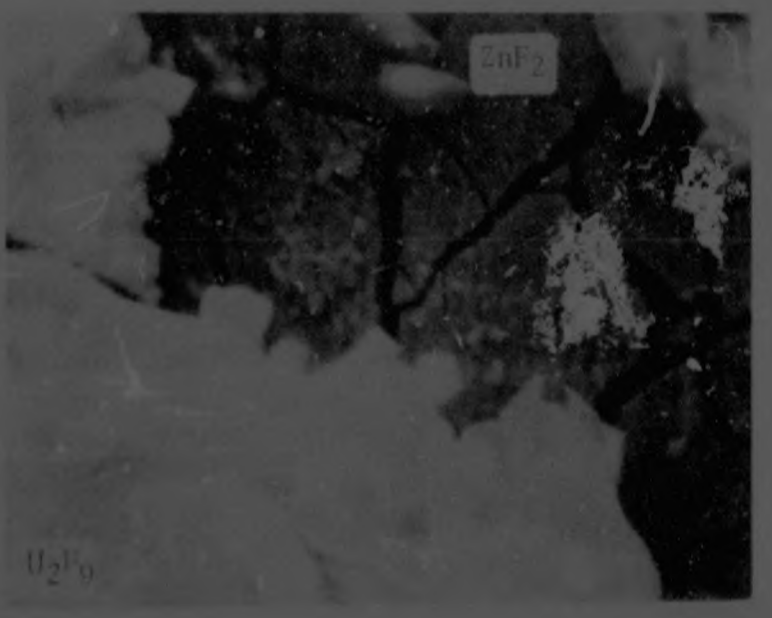

FIGURE 4.9 : SCANNING ELECTRON MICROCRAPH OF 70/30 BRASS SURFACE AFTER 1000 h CONTACT WITH UF_6 AT 150 ^{o}C. SPECIMEN WAS BENT TO REVEAL SURFACE LAYER OF ZnF_2 (x 3000)

FIGURE 4.10 : SCANNING ELECTRON MICROGRAPH OF A MUNTZ METAL SURFACE AFTER 1000 h EXPOSURE TO UF_6 AT 150 ^{o}C. SPECIMEN WAS BENT TO REVEAL SURFACE LAYER OF $Zn F_2$ (x 700)

FIGURE 4.11 : SCANNING ELECTRON IMAGE OF MUNTZ METAL SHOWING LAYER OF U_2F_9 CRYSTALS (A), $Zn F_2$ LAYER (B) AND BARE SUBSTRATE (C) (x 600)

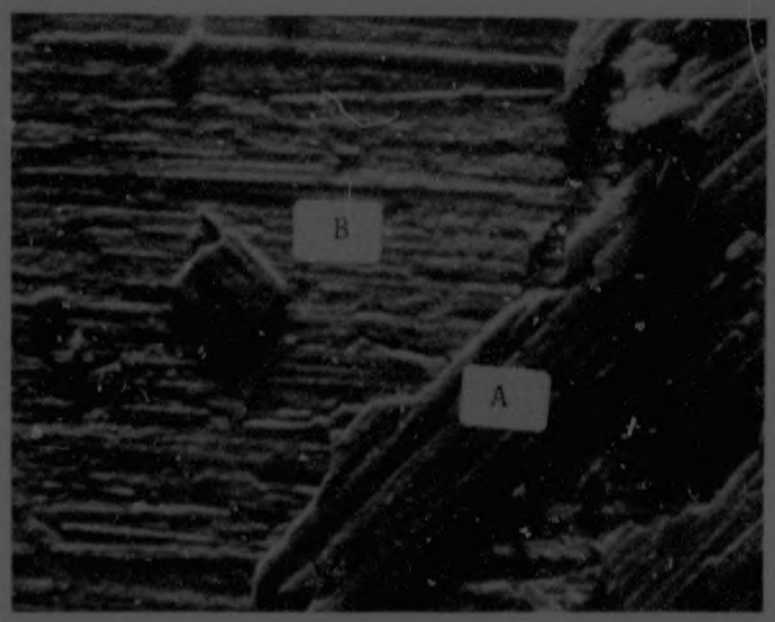

FIGURE 4.12 : CORROSION LAYERS ON MUNTZ METAL DETACHED FROM THE SUBSTRATE AND VIEWED FROM THE METAL SIDE (x 300)

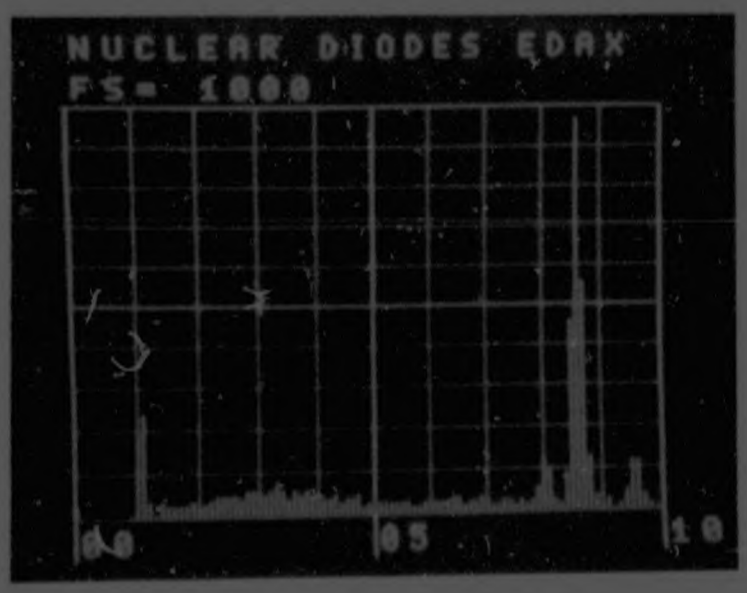

FIGURE 4.13 : COMPOSITION OF AREA A IN FIGURE 4.12

Zn K_α : 8,63 KeV

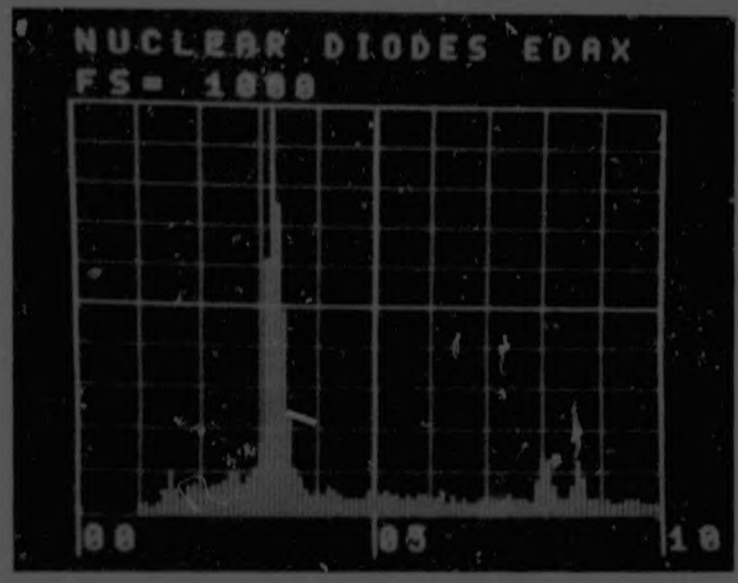

FIGURE 4.14 : COMPOSITION OF AREA B IN FIGURE 4.12

Cu K_α: 8,04 KeV
Zn K_α: 8,63 KeV
U M_α : 3,2 KeV

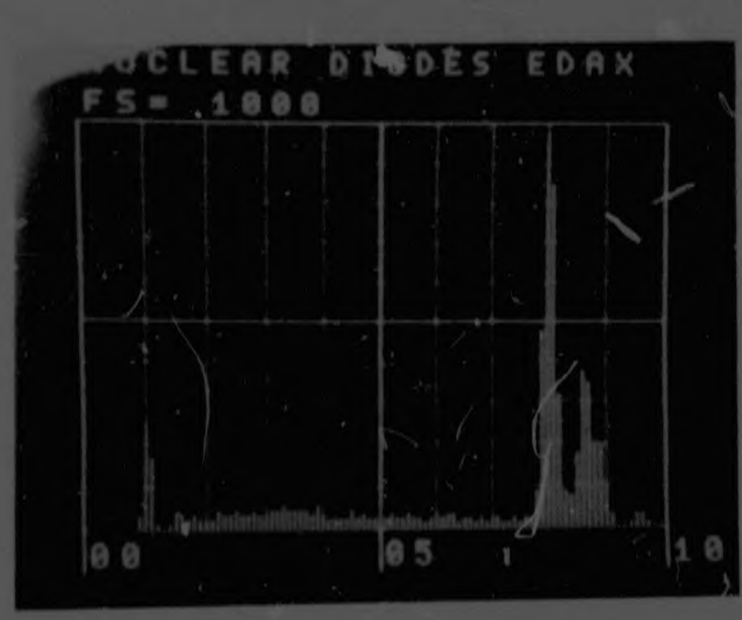

FIGURE 4.15 : COMPOSITION OF AREA C IN FIGURE 4.11

Cu K_α : 8,04 KeV
Zn K_α : 8,63 KeV

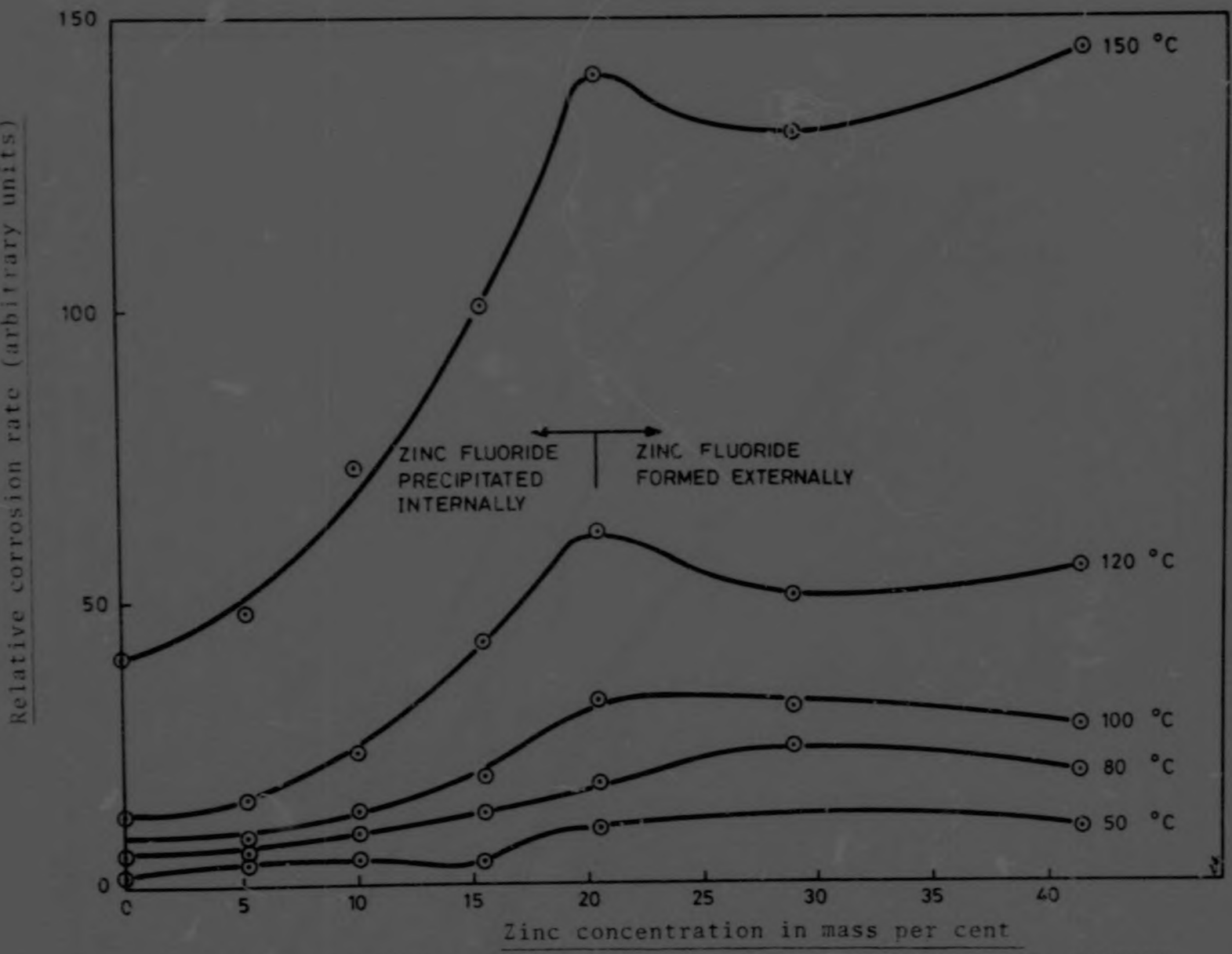

FIGURE 4.16 : CORROSION RATE OF Cu-Zn ALLOYS AS A FUNCTION OF Zn CONTENT AND TEMPERATURE

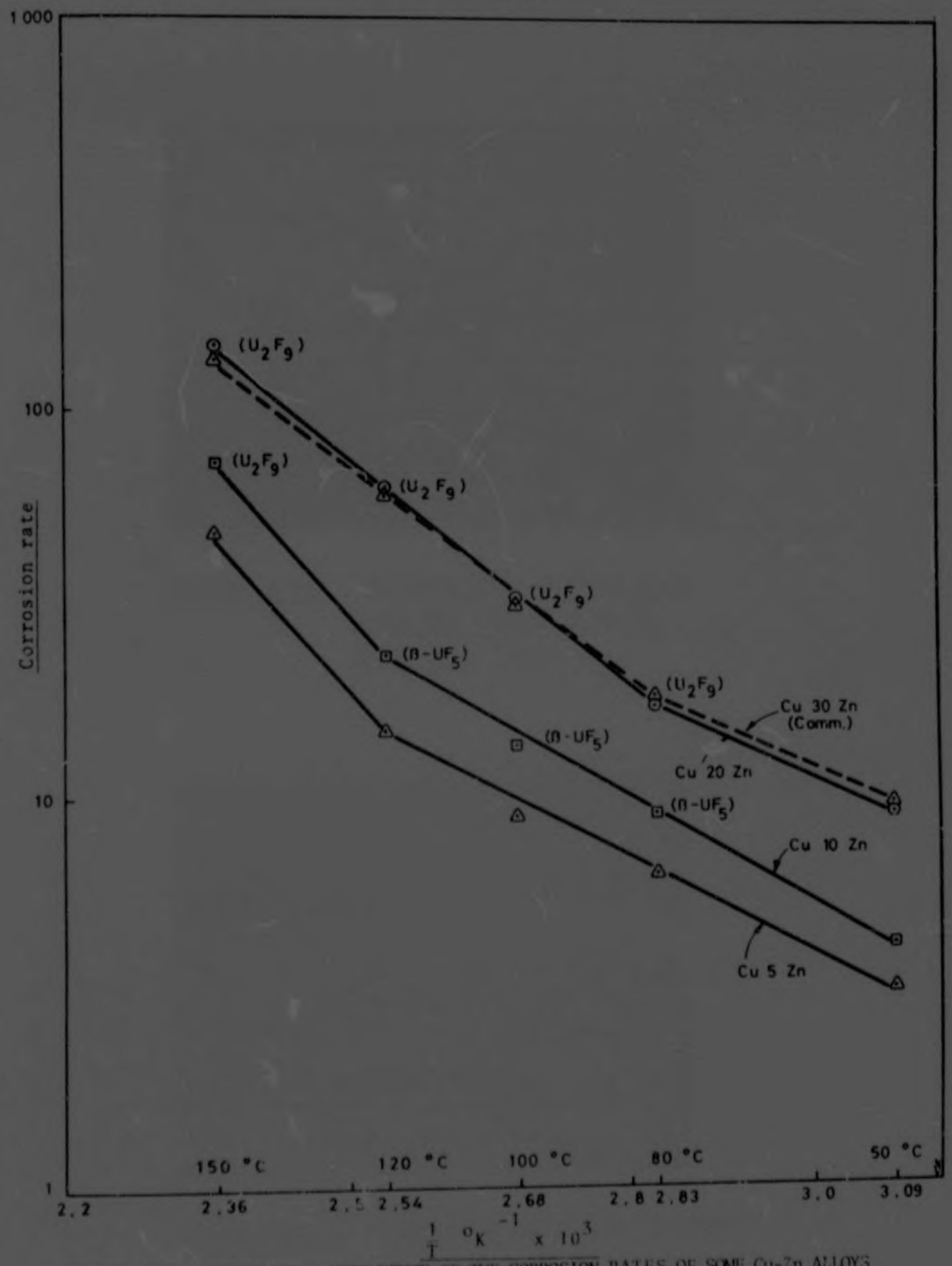

FIGURE 4.17 : TEMPERATURE DEPENDENCE OF THE CORROSION RATES OF SOME Cu-Zn ALLOYS

FIGURE 4.18 : CORROSION CRUST ON NAVAL BRASS AFTER 188 h EXPOSURE TO UF_6 AT 80 ^{o}C (x 1000)

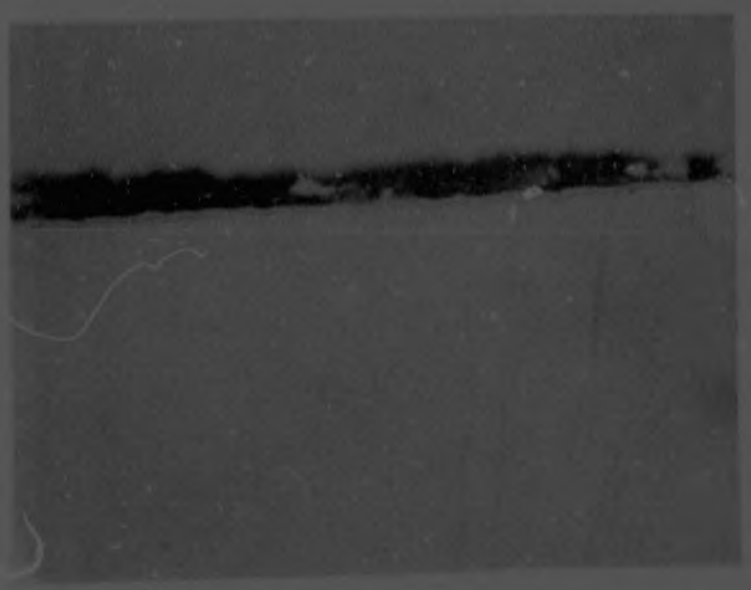

FIGURE 4.19 : SECTION OF NAVAL BRASS SPECIMEN AFTER 163 h UF_6 CONTACT AT 100 ^{o}C. NO SELECTIVE ATTACK IS APPARENT AT THIS TEMPERATURE (x 800)

FIGURE 4.20 : SELECTIVE ATTACK ON THE β-PHASE IN NAVAL BRASS. EXPOSURE : 1000 h AT 150 ^{o}C (x 80)

FIGURE 4.21 : PREFERENTIAL FLUORIDE PENETRATION OF β-PHASE IN NAVAL BRASS. EXPOSURE : 186 h AT 120 ^{o}C (x 800)

FIGURE 4.22 : SECONDARY ELECTRON IMAGE OF AREA SHOWN IN FIGURE 4.21

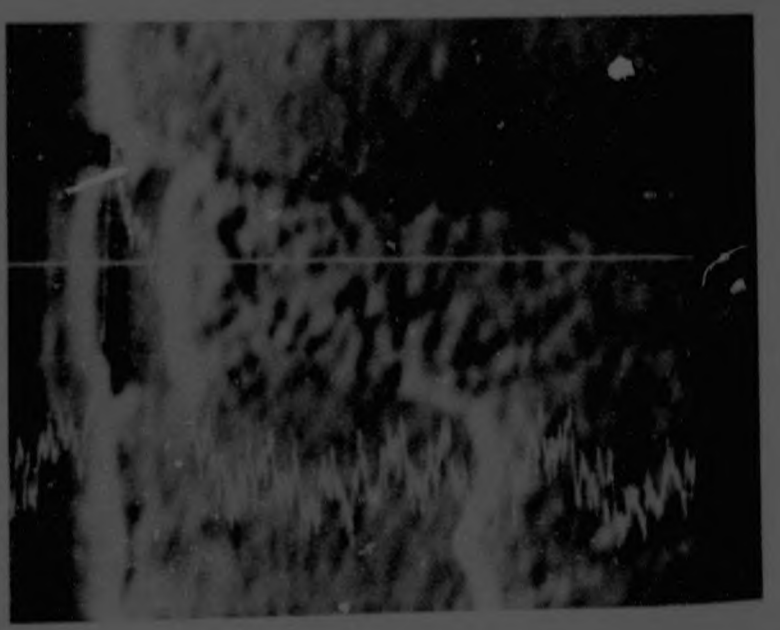

FIGURE 4.23 : AUGER LINE SCAN ACROSS AREA SHOWN IN FIGURE 4.22 SHOWING VARIATION IN FLUORIDE CONCENTRATION

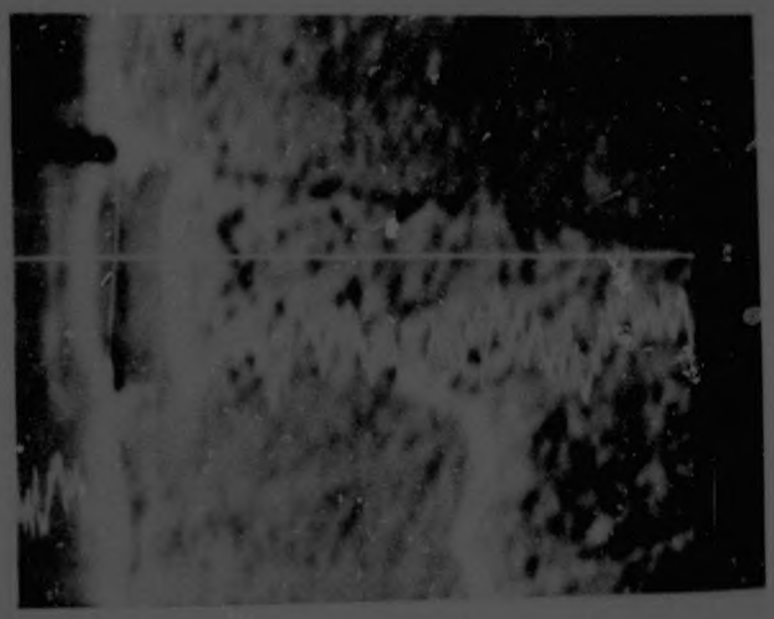

FIGURE 4.24 : AUGER LINE SCAN ACROSS AREA SHOWN IN FIGURE 4.22 SHOWING VARIATION IN ZINC CONCENTRATION

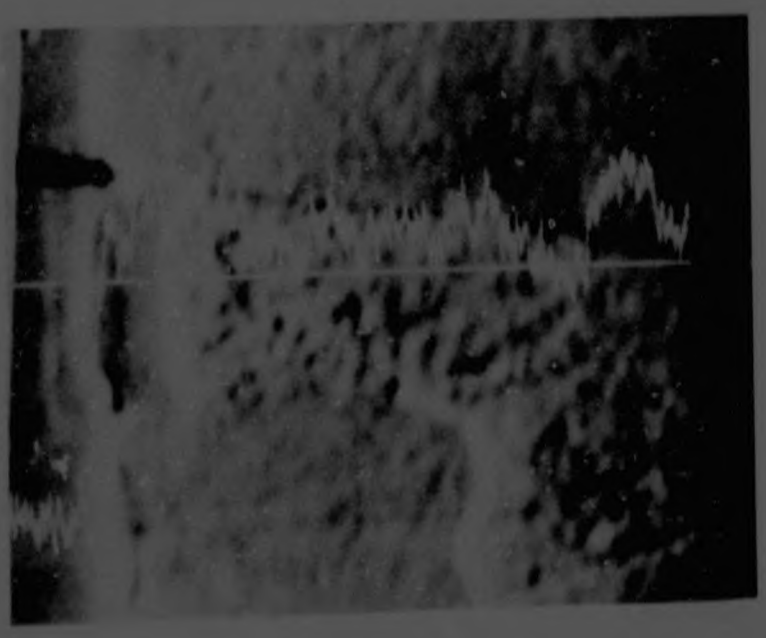

FIGURE 4.25 : AUGER LINE SCAN ACROSS AREA SHOWN IN FIGURE 4.22 SHOWING VARIATION IN COPPER CONCENTRATION

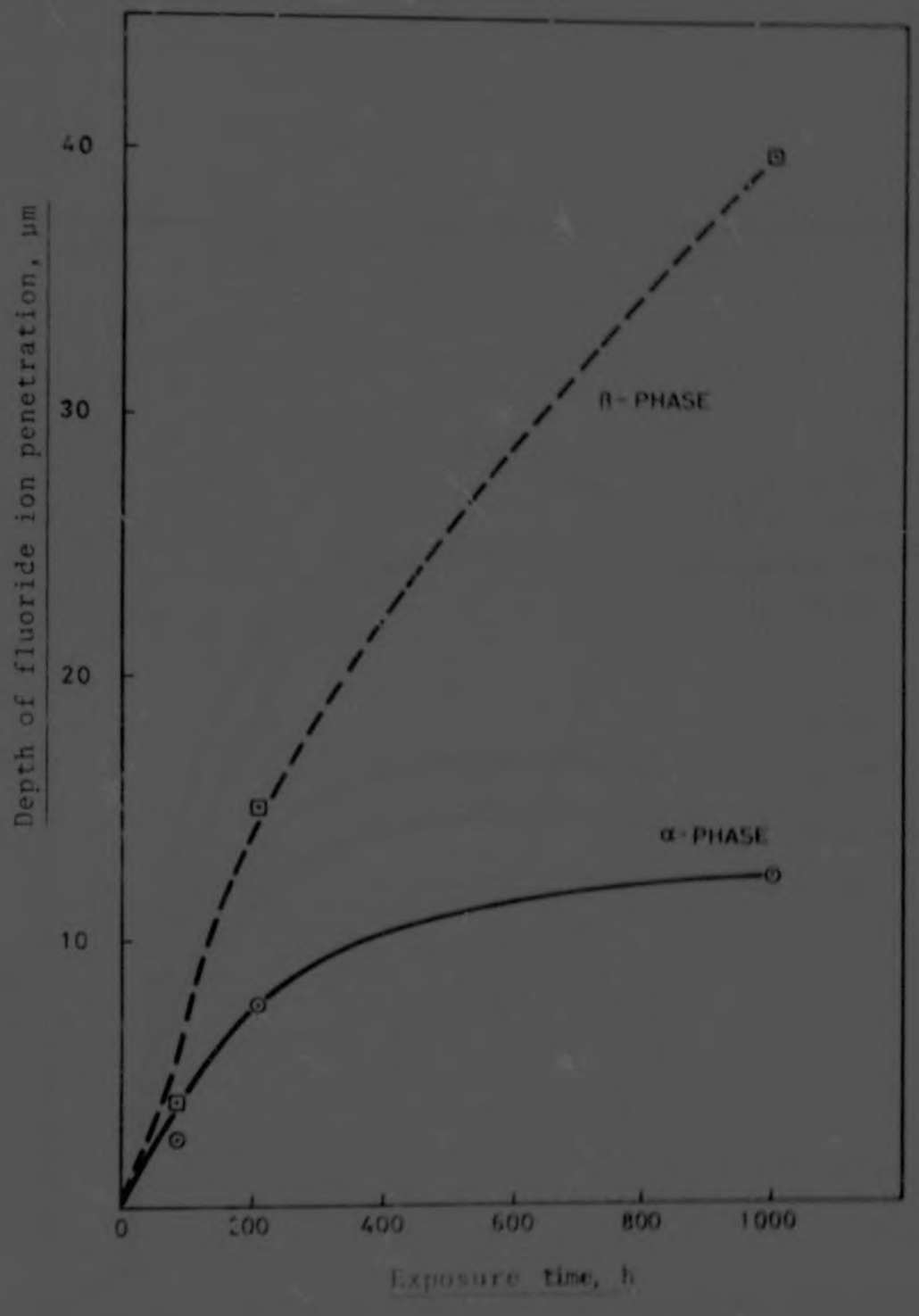

FIGURE 4.26 : SELECTIVE ATTACK BY FLUORIDE IONS ON NAVAL BRASS AT 150 °C

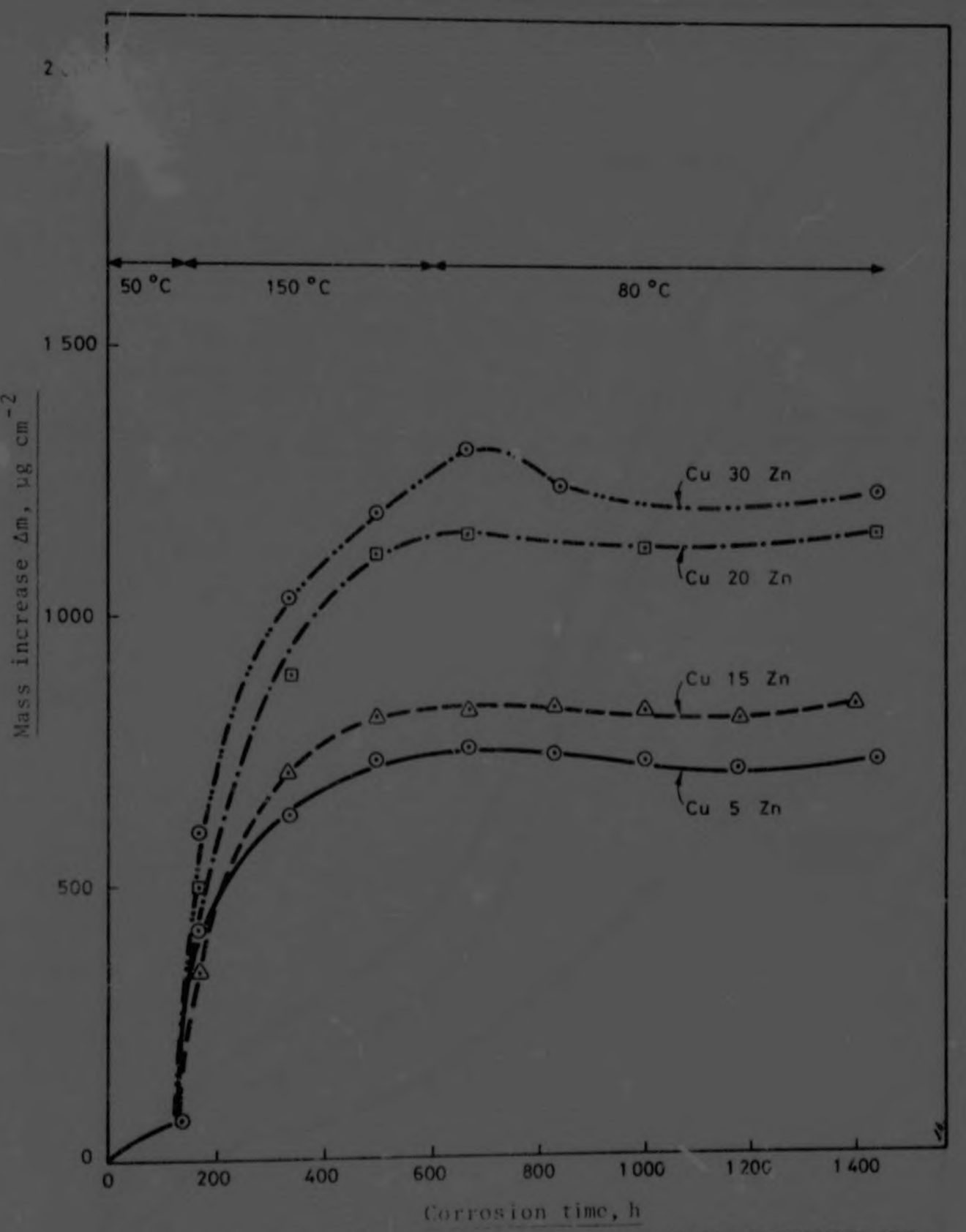

FIGURE 4.27 : TEMPERATURE-CHANGE EXPERIMENT IN WHICH THE TEMPERATURE WAS 50 °C FOR THE INITIAL 140 h, 150 °C FOR 460 h AND 80 °C FOR A FURTHER 840 h

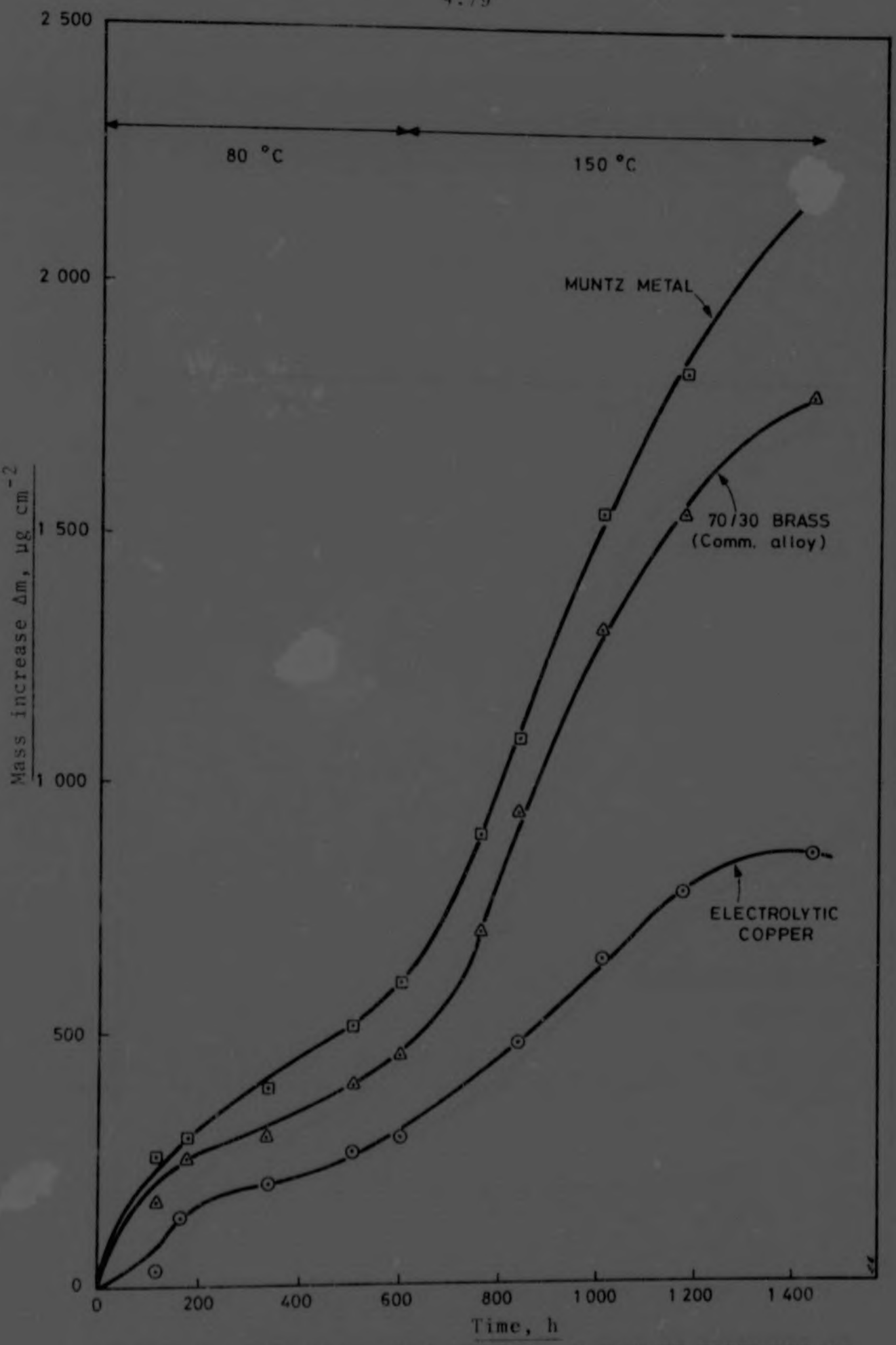

FIGURE 4.28 : TEMPERATURE-CHANGE EXPERIMENT IN WHICH THE TEMPERATURE WAS 80 °C FOR 600 h AND SUBSEQUENTLY INCREASED TO 150 °C

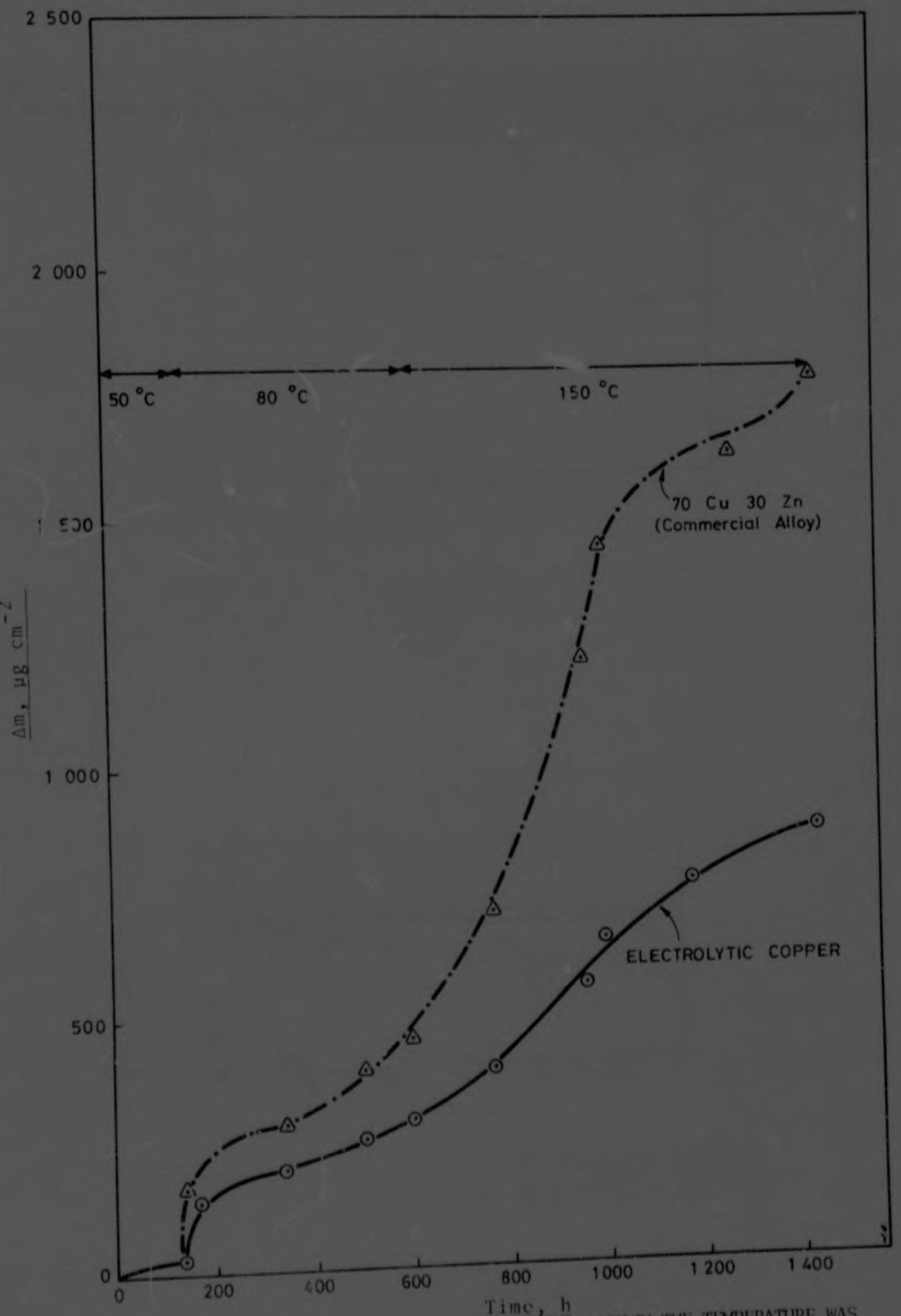

FIGURE 4.29 : TEMPERATURE-CHANGE EXPERIMENT IN WHICH THE TEMPERATURE WAS 50 °C FOR THE INITIAL 140 h, 80 °C FOR 460 h AND 150 °C FOR ANOTHER 840 h

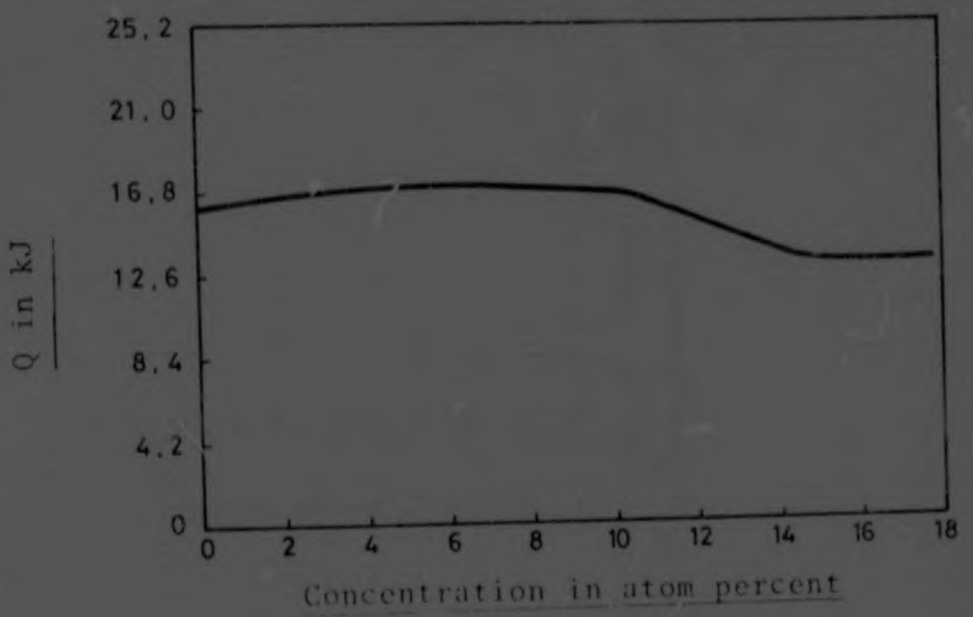

FIGURE 4.30 [4] : RELATIONSHIP BETWEEN Q AND CONCENTRATION FOR THE Cu-Zn SYSTEM

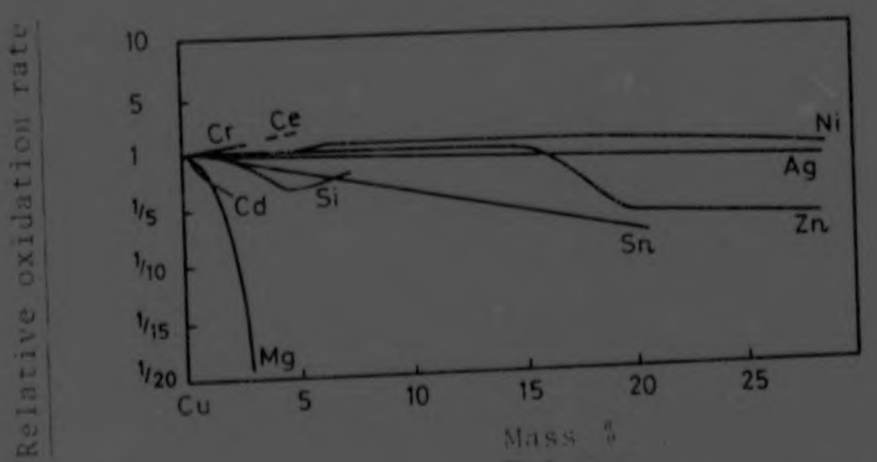

FIGURE 4.31 [5] : EFFECT OF ALLOYING ELEMENTS ON THE OXIDATION OF COPPER

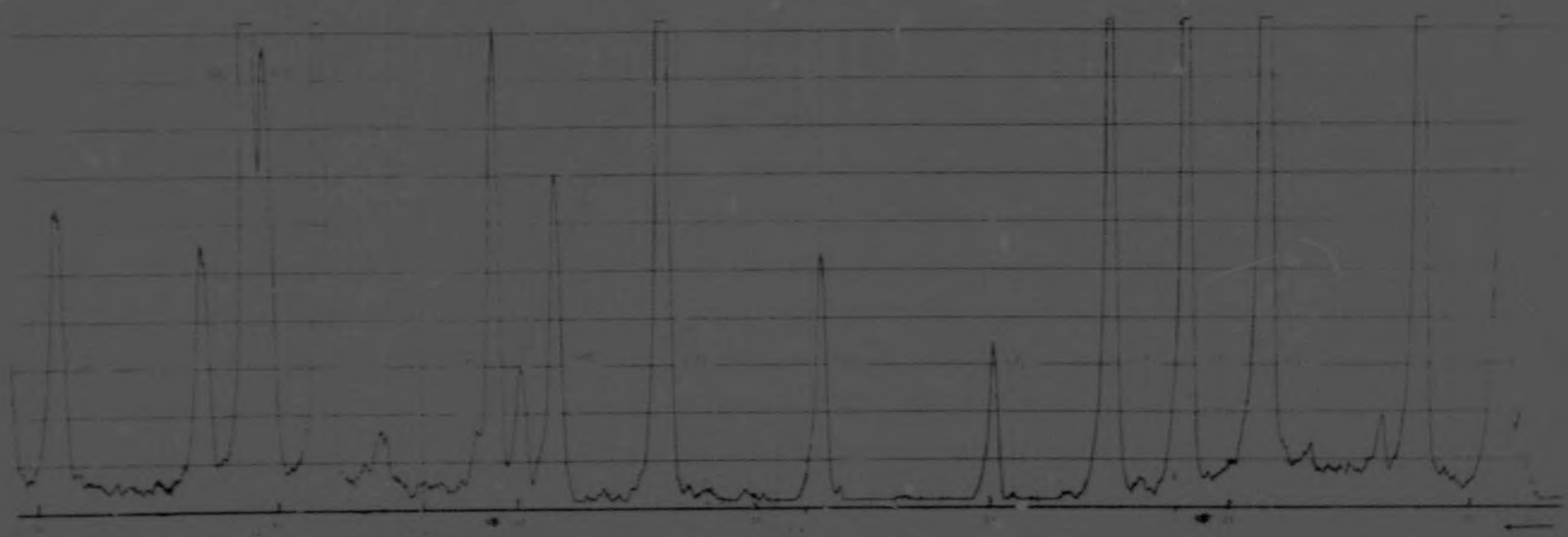

FIGURE 32 : X-RAY DIFFRACTION SPECTRUM FOR MUNTZ METAL. EXPOSURE : 600 h AT 80 ^{o}C, 840 h AT 150 ^{o}C (Cu K_{α})

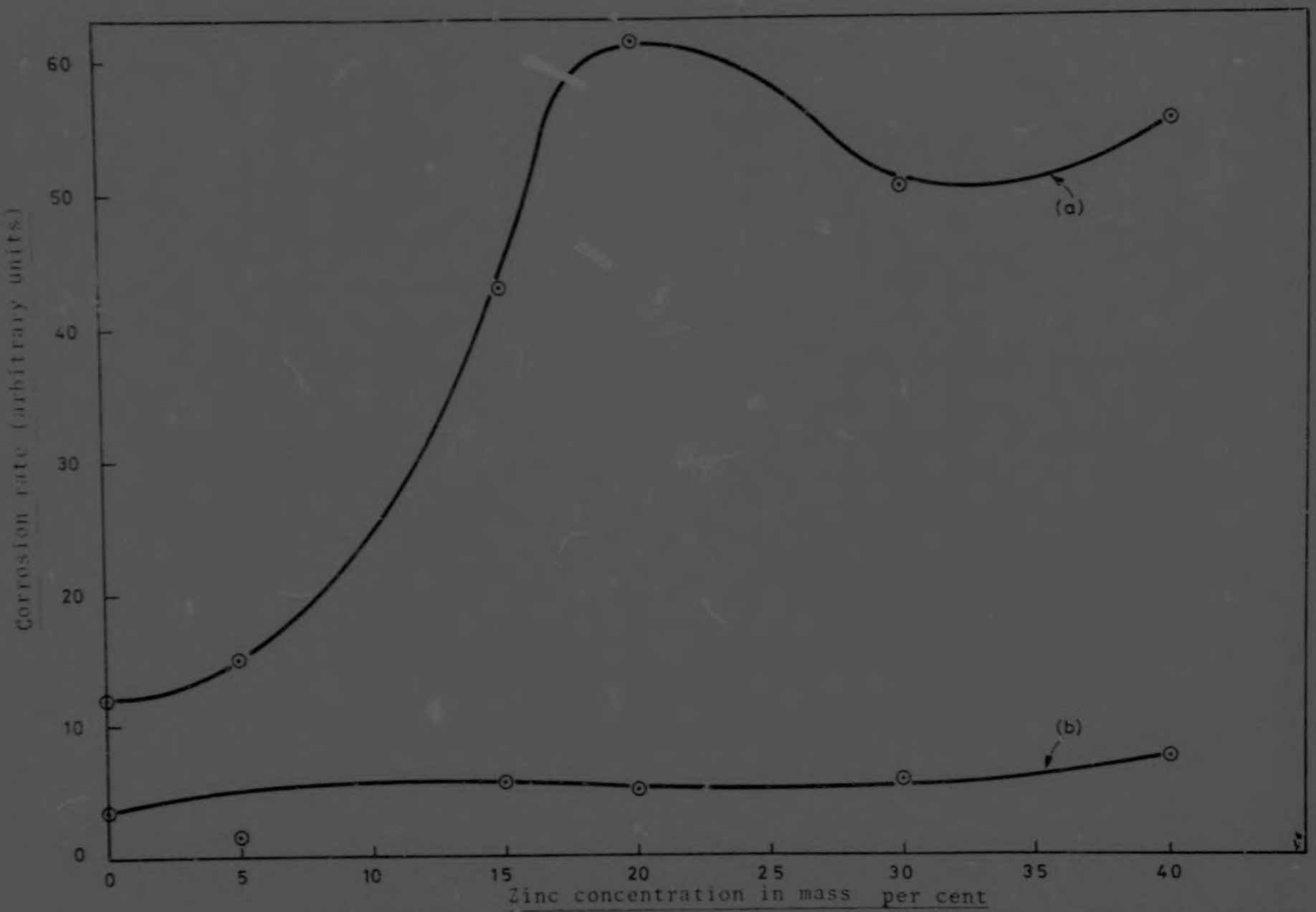

FIGURE 4.33 : CORROSION RATE AT 120 °C IN UF_6 GAS AT 15 kPa AS A FUNCTION OF Zn CONTENT FOR (a) HYDROGEN REDUCED AND (b) AIR OXIDIZED (15 MIN., 150 °C) Cu - Zn ALLOYS