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APPENDICES

APPENDIX A

Photocatalytic performances of films prepared by conventional anodization

Table A-1 Photocatalytic reduction of Hexavalent Chromium Cr(VI) by conventional anodization

Electrolyte: 0.36 M NH_4F +1 M $\text{CH}_3\text{COONH}_4$

Anodization condition: 20 V 3 h

Time (min)	Concentration of Cr(VI) (μM)	C/C ₀
00	204.83	1
0*	204.02	0.99
5	196.49	0.95
10	189.01	0.92
15	182.38	0.89
30	168.98	0.82
45	156.03	0.76
60	146.02	0.71
90	126.42	0.61
120	110.46	0.53
150	95.40	0.46
180	79.46	0.38
210	65.78	0.32
240	53.14	0.25

Electrolyte: 0.36 M NH_4F +1 M CH_3COOH

Anodization condition: 20 V 3 h

Time (min)	Concentration of Cr(VI) (μM)	C/C ₀
00	215.99	1
0	210.90	0.97
5	201.66	0.93
10	195.22	0.90
15	190.87	0.88
30	173.63	0.80
45	154.50	0.71
60	137.42	0.63
90	107.79	0.49
120	83.66	0.38
150	63.68	0.29
180	45.17	0.20
210	25.89	0.11
240	7.93	0.03

Electrolyte: 0.36 M NH_4F +1 M $(\text{NH}_4)_2\text{HPO}_4$

Anodization condition: 20 V 3 h

Time (min)	Concentration of Cr(VI) (μM)	C/C ₀
00	207.52	1
0	197.70	0.95
5	196.10	0.94
10	191.05	0.92
15	187.29	0.90
30	169.32	0.81
45	155.56	0.74
60	145.42	0.70
90	122.53	0.59
120	104.63	0.50
150	88.91	0.42
180	72.25	0.34
210	58.24	0.28
240	45.39	0.21

Electrolyte: 0.36 M NH_4F +1 M H_3PO_4

Anodization condition: 20 V 3 h

Time (min)	Concentration of Cr(VI) (μM)	C/C ₀
00	206.59	1
0	202.90	0.98
5	198.55	0.96
10	188.59	0.91
15	181.59	0.87
30	162.59	0.78
45	147.05	0.71
60	131.03	0.63
90	102.03	0.49
120	79.31	0.38
150	56.99	0.27
180	35.97	0.17
210	17.15	0.08
240	0.327	0.00

Electrolyte: 0.36 M NH_4F +1 M $(\text{NH}_4)_2\text{SO}_4$

Anodization condition: 20 V 3 h

Time (min)	Concentration of Cr(VI) (μM)	C/C ₀
00	212.61	1
0	210.89	0.99
5	203.71	0.95
10	198.27	0.93
15	192.64	0.90
30	175.83	0.82
45	161.13	0.75
60	139.10	0.65
90	117.63	0.55
120	92.60	0.43
150	82.11	0.38
180	75.71	0.35
210	69.40	0.32
240	61.83	0.29

Electrolyte: 0.36 M NH_4F +1 M Na_2SO_4

Anodization condition: 20 V 3 h

Time (min)	Concentration of Cr(VI) (μM)	C/C ₀
00	214.13	1
0	212.33	0.99
5	206.99	0.96
10	194.66	0.90
15	183.03	0.85
30	174.57	0.81
45	154.82	0.72
60	133.53	0.62
90	108.84	0.50
120	86.43	0.40
150	58.88	0.27
180	41.32	0.19
210	21.60	0.10
240	5.23	0.02

Electrolyte: 0.36 M NH₄F + PEG 400

Anodization condition: 20 V 3 h

Time (min)	Concentration of Cr(VI) (μM)	C/C ₀
00	199.21	1
0	195.20	0.97
5	188.46	0.94
10	180.18	0.90
15	172.24	0.86
30	152.11	0.76
45	133.15	0.66
60	116.48	0.58
90	87.23	0.43
120	67.10	0.33
150	50.19	0.25
180	32.19	0.16
210	20.22	0.10
240	11.26	0.05

Electrolyte: 0.36 M NH₄F+1 M D-mannitol

Anodization condition: 20 V 3 h

Time (min)	Concentration of Cr(VI) (μM)	C/C ₀
00	201.78	1
0	200.30	0.99
5	192.29	0.95
10	184.70	0.91
15	179.17	0.88
30	166.89	0.82
45	152.57	0.75
60	139.61	0.69
90	111.29	0.55
120	88.74	0.43
150	66.61	0.33
180	46.71	0.23
210	27.25	0.13
240	12.65	0.06

Electrolyte: 0.36 M NH₄F+Glycerol

Anodization condition: 20 V 3 h

Time (min)	Concentration of Cr(VI) (μM)	C/C ₀
00	201.62	1
0	201.30	0.99
5	187.26	0.92
10	178.02	0.88
15	170.48	0.84
30	150.11	0.74
45	132.41	0.65
60	117.28	0.58
90	88.78	0.44
120	66.61	0.33
150	43.57	0.21
180	26.52	0.13
210	14.05	0.06
240	4.11	0.02

Electrolyte: 0.36 M NH₄F+EG

Anodization condition: 20 V 3 h

Time (min)	Concentration of Cr(VI) (μM)	C/C ₀
00	203.02	1
0	200.98	0.98
5	192.41	0.94
10	185.34	0.91
15	177.98	0.87
30	163.45	0.80
45	151.24	0.74
60	140.44	0.69
90	124.21	0.61
120	106.43	0.52
150	90.65	0.44
180	72.97	0.35
210	55.76	0.27
240	43.11	0.21

Electrolyte: 0.36 M NH_4F

Anodization condition: 20 V 3 h

Time (min)	Concentration of Cr(VI) (μM)	C/C_0
00	199.91	1
0	198.97	0.99
5	187.85	0.93
10	178.63	0.89
15	172.94	0.86
30	155.20	0.77
45	140.47	0.70
60	127.24	0.63
90	103.63	0.51
120	84.51	0.42
150	64.21	0.32
180	42.74	0.21
210	26.52	0.13
240	13.93	0.06

Table A-2 Photocatalytic reduction of Hexavalent Chromium Cr(VI) by pulse anodizationElectrolyte: 0.36 M NH₄F+1 M CH₃COONH₄

Anodization condition: 20 V/ -4 V, 3 h

Time (min)	Concentration of Cr(VI) (μM)	C/C ₀
00	201.61	1
0	197.15	0.97
5	187.74	0.93
10	180.90	0.89
15	175.79	0.87
30	158.71	0.78
45	142.82	0.70
60	127.28	0.63
90	102.92	0.51
120	74.13	0.36
150	55.25	0.27
180	39.61	0.19
210	20.62	0.10
240	6.00	0.02

Electrolyte: 0.36 M NH₄F+1 M (NH₄)₂HPO₄

Anodization condition: 20 V/ -4 V, 3 h

Time (min)	Concentration of Cr(VI) (μM)	C/C ₀
00	194.92	1
0	193.48	0.99
5	187.68	0.96
10	183.47	0.94
15	174.96	0.89
30	162.77	0.83
45	150.69	0.77
60	140.61	0.72
90	122.18	0.63
120	105.77	0.54
150	91.73	0.47
180	78.62	0.40
210	66.51	0.34
240	53.60	0.27

Electrolyte: 0.36 M NH₄F+1 M CH₃COOH

Anodization condition: 20 V/ -4 V, 3 h

Time (min)	Concentration of Cr(VI) (μM)	C/C ₀
00	198.33	1
0	192.991	0.97
5	191.50	0.96
10	183.39	0.92
15	171.73	0.86
30	159.02	0.80
45	145.84	0.73
60	133.18	0.67
90	112.89	0.57
120	93.01	0.46
150	76.52	0.38
180	60.72	0.30
210	47.64	0.24
240	35.41	0.17

Electrolyte: 0.36 M NH₄F+1 M (NH₄)₂SO₄

Anodization condition: 20 V/ -4 V, 3 h

Time (min)	Concentration of Cr(VI) (μM)	C/C ₀
00	196.71	1
0	189.40	0.96
5	182.50	0.92
10	175.72	0.89
15	169.49	0.86
30	154.12	0.78
45	142.42	0.72
60	135.99	0.69
90	116.30	0.59
120	96.08	0.48
150	78.56	0.39
180	61.56	0.31
210	46.70	0.23
240	33.52	0.17

Electrolyte: 0.36 M NH₄F+1 M H₃PO₄

Anodization condition: 20 V/ -4 V, 3 h

Time (min)	Concentration of Cr(VI) (μM)	C/C ₀
00	204.34	1
0	202.49	0.99
5	195.50	0.95
10	189.83	0.92
15	183.49	0.89
30	169.06	0.82
45	157.72	0.77
60	145.08	0.71
90	127.63	0.62
120	106.88	0.52
150	94.42	0.46
180	80.09	0.39
210	69.54	0.34
240	59.83	0.29

Electrolyte: 0.36 M NH₄F + PEG 400

Anodization condition: 20 V/ -4 V, 3 h

Time (min)	Concentration of Cr(VI) (μM)	C/C ₀
00	197.45	1
0	194.58	0.98
5	190.25	0.96
10	185.85	0.94
15	180.55	0.91
30	168.13	0.85
45	156.52	0.79
60	147.00	0.74
90	122.38	0.62
120	104.02	0.52
150	88.46	0.44
180	73.89	0.37
210	62.53	0.31
240	52.84	0.26

Electrolyte: 0.36 M NH₄F+1 M Na₂SO₄

Anodization condition: 20 V/ -4 V, 3 h

Time (min)	Concentration of Cr(VI) (μM)	C/C ₀
00	189.95	1
0	189.21	0.99
5	181.13	0.95
10	172.23	0.90
15	165.68	0.87
30	147.45	0.77
45	132.45	0.69
60	116.36	0.61
90	89.66	0.47
120	67.24	0.35
150	48.58	0.25
180	30.77	0.16
210	14.39	0.07
240	0.15	0.00

Electrolyte: 0.36 M NH₄F+Glycerol

Anodization condition: 20 V/ -4 V, 3 h

Time (min)	Concentration of Cr(VI) (μM)	C/C ₀
00	209.33	1
0	206.84	0.98
5	202.97	0.96
10	199.88	0.95
15	195.87	0.93
30	184.29	0.88
45	172.15	0.82
60	162.17	0.77
90	144.86	0.69
120	117.34	0.56
150	103.73	0.49
180	90.46	0.43
210	78.92	0.37
240	66.65	0.31

Electrolyte: 0.36 M NH_4F +1 M D-mannitol

Anodization condition: 20 V/ -4 V, 3 h

Time (min)	Concentration of Cr(VI) (μM)	C/C ₀
00	198.12	1
0	197.97	0.99
5	191.60	0.96
10	186.62	0.94
15	180.46	0.91
30	163.87	0.82
45	148.90	0.75
60	135.60	0.68
90	110.72	0.56
120	90.85	0.45
150	72.40	0.36
180	54.89	0.27
210	41.45	0.20
240	26.54	0.13

Electrolyte: 0.36 M NH_4F +EG

Anodization condition: 20 V/ -4 V, 3 h

Time (min)	Concentration of Cr(VI) (μM)	C/C ₀
00	204.56	1
0	203.89	0.99
5	197.50	0.96
10	189.79	0.92
15	183.99	0.89
30	169.22	0.82
45	149.38	0.73
60	140.00	0.68
90	117.15	0.57
120	97.49	0.47
150	83.15	0.40
180	69.52	0.33
210	55.48	0.27
240	40.12	0.19

Electrolyte: 0.36 M NH_4F

Anodization condition: 20 V/ -4 V, 3 h

Time (min)	Concentration of Cr(VI) (μM)	C/C ₀
00	206.92	1
0	202.93	0.98
5	200.76	0.97
10	196.97	0.95
15	193.20	0.93
30	185.17	0.89
45	174.10	0.84
60	163.36	0.78
90	143.76	0.69
120	128.17	0.61
150	114.47	0.55
180	102.69	0.49
210	91.46	0.44
240	81.88	0.39

Table A-3 Photocurrent of metal doping TiO₂ nanotube by pulse anodizationElectrolyte: 0.36 M NH₄F+EG+LiF

Anodization condition: 20 V/ -4 V, 3 h

Condition	Photocurrent density (mA/cm ²)
10%+EG+10s	7.46
20%+EG+10s	8.73
30%+EG+10s	8.33
40%+EG+10s	8.02
20%+EG+2s	9.68
20%+EG+5s	10.24
20%+EG+10s	8.73
20%+EG+15s	8.41
20%+w/o+5s	7.54
20%+EG+5s	10.24
20%+Gly+5s	9.37
20%+PEG+5s	7.86

Electrolyte: 0.36 M NH₄F+EG+NiF₂

Anodization condition: 20 V/ -4 V, 3 h

Condition	Photocurrent density (mA/cm ²)
10%+EG+10s	4.37
20%+EG+10s	4.60
30%+EG+10s	6.90
40%+EG+10s	4.92
30%+EG+2s	8.17
30%+EG+5s	6.03
30%+EG+10s	6.90
30%+EG+15s	3.65
30%+w/o+2s	3.57
30%+EG+2s	8.17
30%+Gly+2s	8.65
30%+PEG+2s	4.60

Electrolyte: 0.36 M NH₄F+EG+MnF₃

Anodization condition: 20 V/ -4 V, 3 h

Condition	Photocurrent density (mA/cm ²)
10%+EG+10s	6.35
20%+EG+10s	0.00
30%+EG+10s	0.00
40%+EG+10s	0.16
10%+EG+2s	5.32
10%+EG+5s	8.33
10%+EG+10s	6.35
10%+EG+15s	4.84
10%+w/o+5s	2.54
10%+EG+5s	8.33
10%+Gly+5s	8.73
10%+PEG+5s	6.98

Electrolyte: 0.36 M NH₄F+EG+VF₄

Anodization condition: 20 V/ -4 V, 3 h

Condition	Photocurrent density (mA/cm ²)
10%+EG+10s	5.16
20%+EG+10s	3.97
30%+EG+10s	5.16
40%+EG+10s	3.97
30%+EG+2s	6.27
30%+EG+5s	2.78
30%+EG+10s	5.16
30%+EG+15s	5.56
30%+w/o+2s	3.81
30%+EG+2s	6.27
30%+Gly+2s	7.54
30%+PEG+2s	2.78

Electrolyte: 0.36 M $\text{NH}_4\text{F}+\text{EG}+\text{NbF}_5$

Anodization condition: 20 V/ -4 V, 3 h

Condition	Photocurrent density (mA/cm^2)
10%+EG+10s	8.57
20%+EG+10s	8.49
30%+EG+10s	9.05
40%+EG+10s	9.37
40%+EG+2s	4.92
40%+EG+5s	7.78
40%+EG+10s	9.37
40%+EG+15s	9.13
40%+w/o+10s	1.90
40%+EG+10s	9.37
40%+Gly+10s	8.73
40%+PEG+10s	7.70

Table A-4 Photocatalytic reduction of Hexavalent Chromium Cr(VI) of metal doped TiO₂ nanotube prepared by pulse anodization

Electrolyte: 0.36 M NH₄F+20% w/v LiF

Anodization condition: 20 V/ -4 V (5 s), 3 h

Time (min)	Concentration of Cr(VI) (μM)	C/C ₀
00	193.81	1
0	191.55	0.98
5	180.10	0.92
10	171.55	0.88
15	165.32	0.85
30	147.82	0.76
45	134.78	0.69
60	118.25	0.61
90	90.99	0.46
120	62.01	0.31
150	30.97	0.15
180	0.51	0.00
210	0.00	0.00
240	0.00	0.00

Electrolyte: 0.36 M NH₄F+Glycerol+20% w/v LiF

Anodization condition: 20 V/ -4 V (5 s), 3 h

Time (min)	Concentration of Cr(VI) (μM)	C/C ₀
00	197.22	1
0	190.95	0.96
5	179.87	0.91
10	170.78	0.86
15	160.29	0.81
30	140.25	0.71
45	120.21	0.60
60	99.86	0.50
90	62.37	0.31
120	24.61	0.12
150	0.00	0.00
180	0.00	0.00
210	0.00	0.00
240	0.00	0.00

Electrolyte: 0.36 M NH₄F+EG+20% w/v LiF

Anodization condition: 20 V/ -4 V (5 s), 3 h

Time (min)	Concentration of Cr(VI) (μM)	C/C ₀
00	197.80	1
0	190.39	0.96
5	180.02	0.91
10	170.42	0.86
15	164.80	0.83
30	136.03	0.68
45	117.02	0.59
60	96.15	0.48
90	48.87	0.24
120	13.23	0.06
150	0.00	0.00
180	0.00	0.00
210	0.00	0.00
240	0.00	0.00

Electrolyte: 0.36 M NH₄F+PEG 400+20% w/v LiF

Anodization condition: 20 V/ -4 V (5 s), 3 h

Time (min)	Concentration of Cr(VI) (μM)	C/C ₀
00	198.24	1
0	194.97	0.98
5	173.65	0.87
10	159.42	0.80
15	147.90	0.74
30	110.25	0.55
45	95.17	0.48
60	64.93	0.32
90	26.47	0.13
120	2.01	0.01
150	1.13	0.00
180	0.00	0.00
210	0.00	0.00
240	0.00	0.00

Electrolyte: 0.36 M NH_4F +30% w/v NiF_2

Anodization condition: 20 V/ -4 V (2 s), 3 h

Time (min)	Concentration of Cr(VI) (μM)	C/C ₀
00	199.78	1
0	199.27	0.92
5	180.92	0.87
10	161.55	0.80
15	148.77	0.76
30	118.86	0.65
45	97.02	0.54
60	77.32	0.44
90	39.14	0.24
120	20.76	0.14
150	5.46	0.05
180	0.00	0.00
210	0.00	0.00
240	0.00	0.00

Electrolyte: 0.36 M NH_4F +Glycerol+30% w/v NiF_2

Anodization condition: 20 V/ -4 V (2 s), 3 h

Time (min)	Concentration of Cr(VI) (μM)	C/C ₀
00	197.63	1
0	191.66	0.96
5	153.77	0.77
10	132.10	0.66
15	120.09	0.60
30	90.68	0.45
45	65.31	0.33
60	43.73	0.22
90	4.02	0.02
120	0.00	0.00
150	0.00	0.00
180	0.00	0.00
210	0.00	0.00
240	0.00	0.00

Electrolyte: 0.36 M NH_4F +EG+30% w/v NiF_2

Anodization condition: 20 V/ -4 V (2 s), 3 h

Time (min)	Concentration of Cr(VI) (μM)	C/C ₀
00	200.88	1
0	185.44	0.92
5	175.09	0.87
10	162.07	0.80
15	152.96	0.76
30	130.81	0.65
45	110.16	0.54
60	90.34	0.44
90	49.83	0.24
120	29.34	0.14
150	10.23	0.05
180	2.67	0.01
210	0.00	0.00
240	0.00	0.00

Electrolyte: 0.36 M NH_4F +PEG 400+30% w/v NiF_2

Anodization condition: 20 V/ -4 V (2 s), 3 h

Time (min)	Concentration of Cr(VI) (μM)	C/C ₀
00	197.24	1
0	187.11	0.94
5	166.95	0.84
10	137.78	0.69
15	106.33	0.53
30	82.34	0.41
45	46.52	0.23
60	24.92	0.12
90	8.32	0.04
120	0.00	0.00
150	0.00	0.00
180	0.00	0.00
210	0.00	0.00
240	0.00	0.00

Electrolyte: 0.36 M NH_4F +10% w/v MnF_3

Anodization condition: 20 V/ -4 V (5 s), 3 h

Time (min)	Concentration of Cr(VI) (μM)	C/C ₀
00	204.51	1
0	201.95	0.98
5	177.34	0.86
10	160.11	0.78
15	142.63	0.69
30	116.83	0.57
45	93.43	0.45
60	67.84	0.33
90	31.45	0.15
120	2.394	0.01
150	0.00	0.00
180	0.00	0.00
210	0.00	0.00
240	0.00	0.00

Electrolyte: 0.36 M NH_4F +Glycerol+10% w/v MnF_3

Anodization condition: 20 V/ -4 V (5 s), 3 h

Time (min)	Concentration of Cr(VI) (μM)	C/C ₀
00	195.37	1
0	187.75	0.96
5	163.80	0.83
10	146.30	0.74
15	135.47	0.69
30	98.356	0.50
45	72.84	0.37
60	44.40	0.22
90	11.28	0.05
120	0.00	0.00
150	0.00	0.00
180	0.00	0.00
210	0.00	0.00
240	0.00	0.00

Electrolyte: 0.36 M NH_4F +EG+10% w/v MnF_3

Anodization condition: 20 V/ -4 V (5 s), 3 h

Time (min)	Concentration of Cr(VI) (μM)	C/C ₀
00	198.79	1
0	195.39	0.98
5	174.31	0.87
10	160.97	0.80
15	145.08	0.72
30	106.54	0.53
45	74.11	0.37
60	45.18	0.22
90	6.78	0.03
120	0.00	0.00
150	0.00	0.00
180	0.00	0.00
210	0.00	0.00
240	0.00	0.00

Electrolyte: 0.36 M NH_4F +PEG 400+10% w/v MnF_3

Anodization condition: 20 V/ -4 V (5 s), 3 h

Time (min)	Concentration of Cr(VI) (μM)	C/C ₀
00	202.77	1
0	192.17	0.94
5	175.33	0.86
10	163.20	0.80
15	150.62	0.74
30	124.64	0.61
45	96.12	0.47
60	68.70	0.33
90	23.33	0.11
120	0.38	0.00
150	0.00	0.00
180	0.00	0.00
210	0.00	0.00
240	0.00	0.00

Electrolyte: 0.36 M NH_4F +30% w/v VF_4

Anodization condition: 20 V/ -4 V (2 s), 3 h

Time (min)	Concentration of Cr(VI) (μM)	C/C ₀
00	203.65	0.32
0	199.43	0.31
5	181.93	0.28
10	173.53	0.27
15	166.15	0.26
30	150.47	0.23
45	135.28	0.21
60	119.02	0.18
90	88.49	0.14
120	66.66	0.10
150	32.00	0.05
180	7.09	0.01
210	0.00	0.00
240	0.00	0.00

Electrolyte: 0.36 M NH_4F +Glycerol+30% w/v VF_4

Anodization condition: 20 V/ -4 V (2 s), 3 h

Time (min)	Concentration of Cr(VI) (μM)	C/C ₀
00	196.75	1
0	181.69	0.92
5	167.75	0.85
10	152.30	0.77
15	143.83	0.73
30	126.41	0.64
45	106.92	0.54
60	93.61	0.47
90	55.14	0.28
120	19.51	0.09
150	0.00	0.00
180	0.00	0.00
210	0.00	0.00
240	0.00	0.00

Electrolyte: 0.36 M NH_4F +EG+30% w/v VF_4

Anodization condition: 20 V/ -4 V (2 s), 3 h

Time (min)	Concentration of Cr(VI) (μM)	C/C ₀
00	201.15	1
0	190.59	0.94
5	175.54	0.87
10	165.37	0.82
15	152.89	0.76
30	129.36	0.64
45	106.39	0.52
60	81.98	0.40
90	50.48	0.25
120	14.54	0.07
150	0.00	0.00
180	0.00	0.00
210	0.00	0.00
240	0.00	0.00

Electrolyte: 0.36 M NH_4F +PEG 400+30% w/v VF_4

Anodization condition: 20 V/ -4 V (2 s), 3 h

Time (min)	Concentration of Cr(VI) (μM)	C/C ₀
00	201.37	1
0	200.32	0.99
5	174.74	0.86
10	159.41	0.79
15	150.62	0.74
30	127.78	0.63
45	101.08	0.50
60	80.73	0.40
90	41.25	0.20
120	8.56	0.04
150	0.00	0.00
180	0.00	0.00
210	0.00	0.00
240	0.00	0.00

Electrolyte: 0.36 M NH₄F+40% w/v NbF₅

Anodization condition: 20 V/ -4 V (10 s), 3 h

Time (min)	Concentration of Cr(VI) (μM)	C/C ₀
00	201.16	1
0	196.10	0.97
5	182.66	0.90
10	163.93	0.81
15	155.85	0.77
30	127.85	0.63
45	105.40	0.52
60	80.09	0.39
90	34.10	0.16
120	0.00	0.00
150	0.00	0.00
180	0.00	0.00
210	0.00	0.00
240	0.00	0.00

Electrolyte: 0.36 M NH₄F+Glycerol+40% w/v NbF₅

Anodization condition: 20 V/ -4 V (10 s), 3 h

Time (min)	Concentration of Cr(VI) (μM)	C/C ₀
00	198.68	1
0	193.15	0.97
5	174.76	0.87
10	156.89	0.78
15	140.48	0.70
30	108.45	0.54
45	79.27	0.39
60	53.06	0.26
90	7.37	0.03
120	0.00	0.00
150	0.00	0.00
180	0.00	0.00
210	0.00	0.00
240	0.00	0.00

Electrolyte: 0.36 M NH₄F+EG+ 40% w/v NbF₅

Anodization condition: 20 V/ -4 V (10 s), 3 h

Time (min)	Concentration of Cr(VI) (μM)	C/C ₀
00	200.94	1
0	197.64	0.98
5	188.77	0.93
10	168.84	0.84
15	156.69	0.77
30	128.49	0.63
45	99.89	0.49
60	77.83	0.38
90	32.60	0.16
120	0.61	0.00
150	0.00	0.00
180	0.00	0.00
210	0.00	0.00
240	0.00	0.00

Electrolyte: 0.36 M NH₄F+PEG 400+ 40% w/v NbF₅

Anodization condition: 20 V/ -4 V (10 s), 3 h

Time (min)	Concentration of Cr(VI) (μM)	C/C ₀
00	192.79645	1
0	190.76298	0.98
5	177.93254	0.92
10	165.58058	0.85
15	154.50032	0.80
30	129.46272	0.67
45	107.85622	0.55
60	85.85939	0.44
90	45.90563	0.23
120	1.14347	0.00
150	0.00	0.00
180	0.00	0.00
210	0.00	0.00
240	0.00	0.00

APPENDIX B

Journal publication list

1. **Chanmanee, W.**, Watcharenwong, A., Chenthamarakshan, C. R., Kajitvichyanukul, P., de Tacconi, N. R. and Rajeshwar, K. (2007) Titania nanotubes from pulse anodization of titanium foils. *Electrochemistry Communications*, Vol. 9 , pp. 2145–2149.
2. **Chanmanee, W.**, Watcharenwong, A., Chenthamarakshan, C. R., Kajitvichyanukul, P., de Tacconi, N. R. and Rajeshwar, K. (2007) Formation and Characterization of Self-Organized TiO₂ Nanotube Arrays by Pulse Anodization. *Journal of the American Chemical Society*, (Accepted)
3. Watcharenwong, A., **Chanmanee, W.**, de Tacconi, N. R., Chenthamarakshan, C. R., Kajitvichyanukul, P. and Rajeshwar, K. (2007) Anodic growth of nanoporous WO₃ films: morphology, photoelectrochemical response and photocatalytic activity for methylene blue and hexavalent chrome conversion. *Journal of Electroanalytical Chemistry*, (Accepted)
4. Watcharenwong, A., **Chanmanee, W.**, de Tacconi, N. R., Chenthamarakshan, C. R., Kajitvichyanukul, P. and Rajeshwar, K. (2007) Self-organized TiO₂ nanotube arrays by anodization of Ti substrate: Effect of anodization time, voltage and medium composition on oxide morphology and photoelectrochemical response. *Journal of Materials Research*, Vol. 22, pp. 3186-3195.

REFEREED CONFERENCE PROCEEDINGS

1. **Chanmanee, W.**, Watcharenwong, A., Chenthamarakshan, C. R., Kajitvichyanukul, P., de Tacconi, N. R. and Rajeshwar, K. (2007) Formation of self-organized TiO₂ nanotube arrays by pulse anodization. The 14th Semiconducting and Insulating materials Conference (SIMC-XIV) May 15 – 20, 2007, University of Arkansas, Fayetteville, Arkansas, USA.
2. **Chanmanee, W.**, Watcharenwong, A., Chenthamarakshan, C. R., Kajitvichyanukul, P., de Tacconi, N. R. and Rajeshwar, K. (2007) Self-Organized Titanium Dioxide Nanotube Arrays by Pluse Anodization. The 212th ECS meeting (The Electrochemical Society), October 7-12, 2007, Washington, DC, USA.

BIOGRAPHY

Miss Wilaiwan Chanmanee was born on April 16, 1981 in Suphanburi, Thailand. She received her Bachelor's degree in environmental science and technology from Mahidol University, Thailand in 2003. She received her Master's degree in environmental engineering from Kasetsart University in 2005. She pursued her Philosophy of Doctoral Degree studies in the International Postgraduate Program in Environmental Management (Hazardous Waste Management), Inter-Department of Environmental Management Chulalongkorn University, Bangkok, Thailand on May, 2005. She finished her Philosophy of Doctoral Degree in December 2007.