

## MatSE 561- Metal Electrode Reactions Course Outline - Spring 2004

Class (20 Sources	04) Topics		
1 (1/13)	Aims; Team project; Research proposal; Double layer (dl); Conditions for $E^{eq}$ , $E_{mix}$ , $E_{cor}$ ; IR & $E_{meas}$ at surfaces & in Recesses,.	MatSE 421 Lectures: Ch I Intro, I-4-4, III-1-3, I-5-2, I- 5-3; B&F 1-27, 375-377, 538-546	
2 (1/15)	Team Project: Sensors in concrete	T. Y. Won, PhD & R. Wolfe MS Theses, PSU; B&F 73- 80	
3 (1/20 & 1/22)	WE Issues, Crevice corrosion at WE? Galvani potential, $\phi$ , at interface/dl & cell; $\phi$ , IR & E in recesses	WE handout 1-11; Ch 1 Intro, I-5-1 to I-5-3; B&F 54- 59	
4 (1/27)	IR & composition in localized corrosion; $E_{cor}$ in active region; i – E actual & measured curves, Mixed potential theory (MPT)	Crevice handout 1-6; JES, <b>150</b> , K1 (2003), <b>148</b> , B313 (2001); II-6, II-7-1	
5 (1/29)	IR Correction; Meter & actual rate; Charge conservation; I-E & I-η plots; Circuits; Charge transfer & mass transport controls; Butler- Volmer & Tafel eqs.; Passivity, Nernst Eq.	I-5-2, I-5-3, II-1-4 to II-5-2 of MatSE 421	
6 (2/3 & 2/5)	Evaluation of team report		
7 (2/10 & 2/12)	Actively dissolving metals & E <sub>cor</sub> vs. time, pH & inhibitor action;	E <sub>cor</sub> pH & inhibitor handouts; I-7-1; II-6, II-7-1;	
8 (2/17)	$E_{cor}$ – BTA/Zn system, activation & concentration control, effect of $O_2$ ;	JES, 150, B176 (2003); II-3- 3, II-4-1, B&F 20-22	
9 (2/19)	MPT & recesses, $E_{cor} = E_{cathode}$ ; $R_p$ issues	Plating & SF, <b>91</b> (1), 34 (2004); II-8-1, II-8-2, III-5-1	
10 (2/24)	Review		
11 (2/26)	Midterm 1		
12 (3/2)	Closing WE Issues: current distribution, spherical WE, IR polarization; Counter and reference electrode issues.	Shih, JES, 134 (3), 551 (1987); CE & RE handout; B&F 22-26,52,53; J: 97-106	

13 (3/4)	Impedance of RE & of RE circuit; data issues			
14 (3/16 & 3/18)	Electrolyte/cell issues: metal/electrolyte systems; mechanistic vs. characterization (lifetime) research; pre-electrolysis; R <sub>ct</sub> vs. R <sub>p</sub>	SC03L5 handout; B&F: 105		
15 (3/23)	Limiting cases of $R_{ct}$ ; IPE, electrocapillarity & $C_{dl}$ ;	B&F: 6-14, 494-510;		
16 (3/25)	Impedance measurements	B&F: 316-319; JES, 115 (7), 690-694 (1968)		
	IR control; polarizable electrode			

Prerequisite: MatSE 421 (lecture notes on line: url available in class)

Library References (on reserve in Deike library) - A. J. Bard, L. R. Faulkner, Electrochemical Methods, Wiley & Sons, 1980 - D. A. Jones, Corrosion, Macmillan, 1992

Student performance will be accessed from closed book test and quiz scores, homework scores and class participation (questions posed and discussion contributed in class).

This course adopts the College's academic integrity policy which can be found at http://www.ems.psu.edu/students/integrity/statement.html.

## **Instructor**

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<b>Teaching Assistants</b>							

Last up-date: April 30, 2004.