

Analytical Chemistry Cumulative Exam

Topic: Analysis of Surfaces

October 1st, 2015

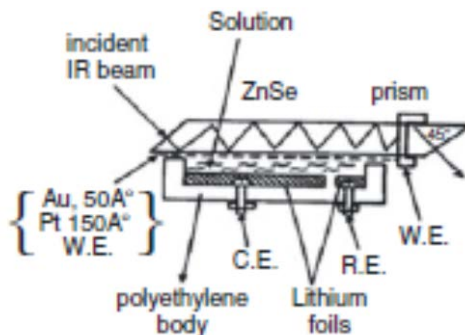
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A few rules:

- No calculator is needed for this exam.
- Please read the questions fully and carefully before answering.
- One the critical aspects of a successful scientific article is conciseness. This is your opportunity to prepare. Please justify your answers *adequately, but concisely*.
- Please **print legibly!**
- Last but not least, I will borrow two lines,
 - one from Prof. Snee: **DON'T PANIC!**
 - one from Forest Gump: *Life is like a box of chocolates.*

The pass line is at 55%.

- 1) (10%) **Name three** methods of analyte extraction that can be used in methodologies based on mass spectrometry.
- 2) (10%) What is the **fundamental difference** between infra-red and Raman spectroscopy?
- 3) (10%) Which of the following techniques **does not** require an electronically conductive substrate: STM or AFM? **Why?**
- 4) (10%) **Succinctly describe** the basic principle of NMR spectroscopy. Please be sure to name the source of the excitation and the nature of the measured signal.
- 5) (5%) **Name** the modality of infra-red spectroscopy depicted in the following diagram:



- 6) (5%) According to the book chapter you read, “*DEMS has been used extensively for the study of gases formed during either the reductive or oxidative decomposition of battery electrolytes on electrode surfaces*”. **What does DEMS stand for?**
- 7) (30%) **Create** a table that contrasts **three (3) characteristic features** of analysis of phenomena at electrode surfaces by XPS, EIS and FTIR. In other words, you should identify features that distinguish a given technique(or techniques) from the rest, as a means to provide a “selection rule” depending on

the problem of interest. The table should appear as shown below (you should draw it by hand in your answer booklet, then fill in the blanks).

Characteristic Feature of Analysis	XPS	EIS	FTIR

Bonus questions

- 1) (5%) Name two faculty in the Department of Chemistry with vigorous activities in the area of mass spectrometry.
- 2) (5%) Name the Department of Chemistry Safety Officer.
- 3) (5%) What is the minimum personal protective equipment you must wear whenever you enter a lab?
- 4) (5%) What personal protective equipment must you wear when filling a liquid nitrogen dewar?