

April 11, 2005

➤ **Review Session for Exam #3:**
Monday, April 18th, 5 pm, B203

➤ **Stay tuned for:**

- Exam #3 Info Page
- Problem Set #4 Solutions
- Winning Lottery Numbers

1

Multichannel Detection

➤ Another way to get *multiplex advantage*:
use multichannel detector (CCD)

- **Example**; with low-power UV excitation:
 - ✓ *ppb detection limits* for PAHs
 - ✓ surface studies: *sub-monolayer* detection
 - ✓ *speed* (30 secs to acquire spectrum that would have taken 5 hours with scanning instrument)
 - ✓ *ns time-resolution*

2

Near-IR Excitation: *Revisited*

Goal: Raman for the masses!

➤ Near-IR excitation

- ✓ fluorescence gone
- ✓ inexpensive diode laser source

➤ Multichannel detection

- ✓ gives S/N boost
- ✓ fast

➤ Fiber Optic probe "sample cell"

- ✓ eliminates laser/sample alignment issues

3

Simple, Low-Cost Raman?

• Source:

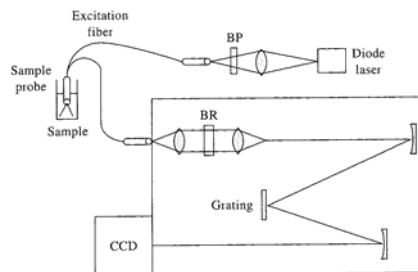
30-mW, 783-nm
diode laser

• Dispersion:

$\frac{1}{4}$ -m, 600-g/mm
grating spectrograph
($D^{-1} = 50 \text{ \AA/mm}$)

• Detector:

1152 pixel CCD
($22.5 \mu\text{m/pixel}$)



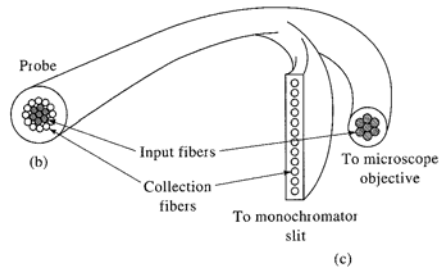
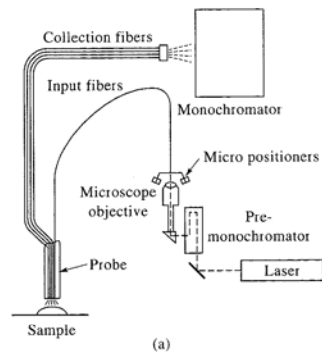
$\sim 1.6 \text{ cm}^{-1}/\text{pixel} = \sim 2000 \text{ cm}^{-1} \bar{\nu}\text{-range}$

4

Fiber Optic Sampling

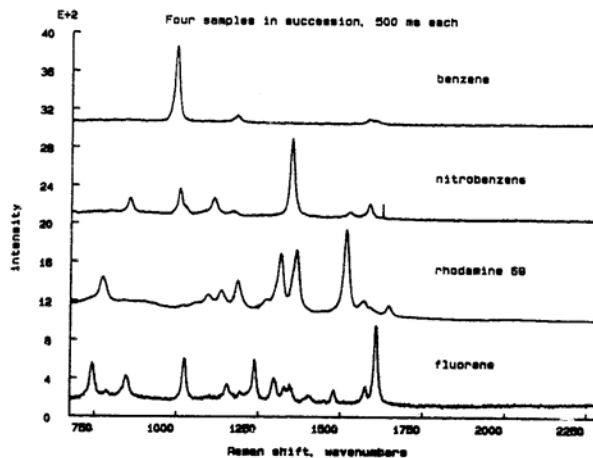
"User-Friendly Sampling"

- eliminates need for precise alignment of laser and sample
- place *directly in solution* containing the sample
- place *directly above solid* sample



Spectral Results

- **rapid** spectral acquisition (500 ms)
- **easy** sampling of solutions and solids
- **no fluorescence** background



Raman: What is it good for?

➤ Vibrational Spectral Analysis

- ✓ complementary with IR
- ✓ molecular structural info
- ✓ easy and fast!

➤ Quantitative Analysis

- ✓ can be as sensitive as fluorescence
- ✓ more selective than fluorescence

Raman as a detection method for separations? See:
<http://www.umich.edu/~morgroup/virtual/labeled/virtual.html> 7

Mass Spectrometry

Chem 221
Instrumental Analysis
Spring 2005

Background

- Method for *separating and quantifying gas phase ions* according to their **mass-to-charge ratio**
- **NOT A SPECTROSCOPIC METHOD!**
-no EMR interactions measured
- **Mass Spec is a SEPARATIONS technique**
-ions are *separated physically* based on mass

9

General Instrumental Scheme

Ion Source:

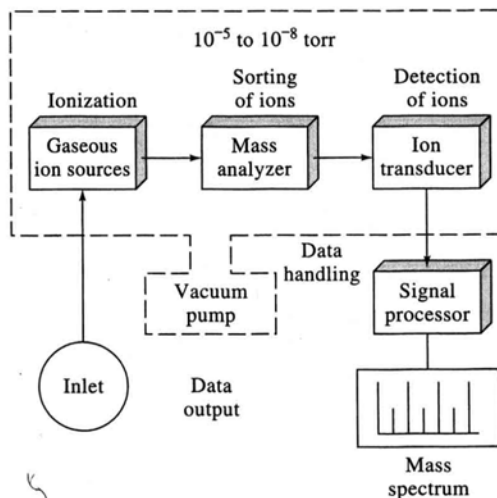
- converts sample to gas phase
- ionizes sample

Mass Analyzer:

- "sorts" ions according to mass-to-charge ratio

Detector:

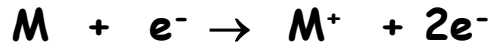
- converts ions to electrical signal proportional to # of ions



How are ions generated?

- Simplest, most common method:

Electron Impact (EI) Ionization



Analyte molecule High energy electron Molecular ion

-if M^+ has sufficient *internal energy* it can fragment:

