

March 9, 2005

➤ Exam #2

- 1 week from today (7 pm, B104)
- Review Session: Sunday, 7pm, B203
- Info Page *now online!*
- Prob Set #3 Solutions *now online!*
- *Now with extra fiber!*

➤ Office Hours - *modifications this week*

- Thursday: 12 - 1:30 pm (Waterman)
- Friday: 1:15 - 1:45 pm (A223 Cook)

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Sample Cells

-Cell windows made of alkali-metal halide (KBr, CsI, NaCl, etc.); largely transparent in IR

■ Solids (particulates should be *smaller* than λ_{IR})

-mix with KBr and press into a pellet

OR

-grind with *heavy hydrocarbon oil* (Nujol®) or *halogenated polymer* (Fluorolube®)

-view resulting mull as a film between salt plates

■ Gases

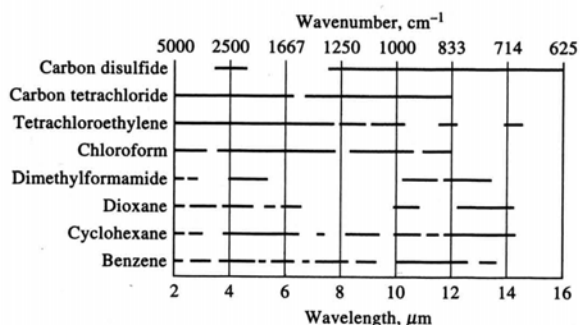
-use *long pathlength* (up to 1000 meters!) to get adequate sensitivity

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Solution Samples

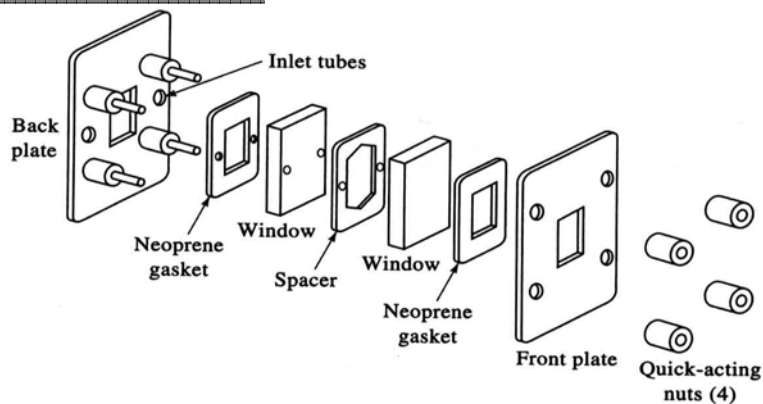
■ Solvents

-choose carefully, based on IR absorption and reactivity with salt windows (avoid water, alcohols)



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More Solution Samples

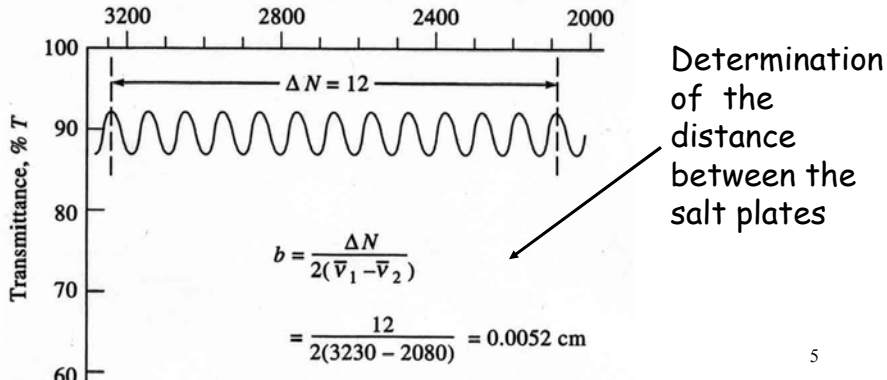


-narrow cell pathlengths (10 μm - 1 mm) needed to minimize absorption due to solvent

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Determining Cell Pathlength

- Get interference pattern due to constructive/destructive interference of EMR waves that are reflected between the salt plates:



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Detectors

- **Thermal** - based on temperature detection
 - **Thermocouple**
 - poor sensitivity
 - *slow* (>ms response time) - *not suitable for FT-IR*
 - **TGS (Triglycine Sulfate)**
 - based on *pyroelectric effect* (temperature dependant capacitance)
 - *fast enough for FT-IR* (but less sensitive than thermocouple)
 - most common detector for FT-IR

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More Detectors

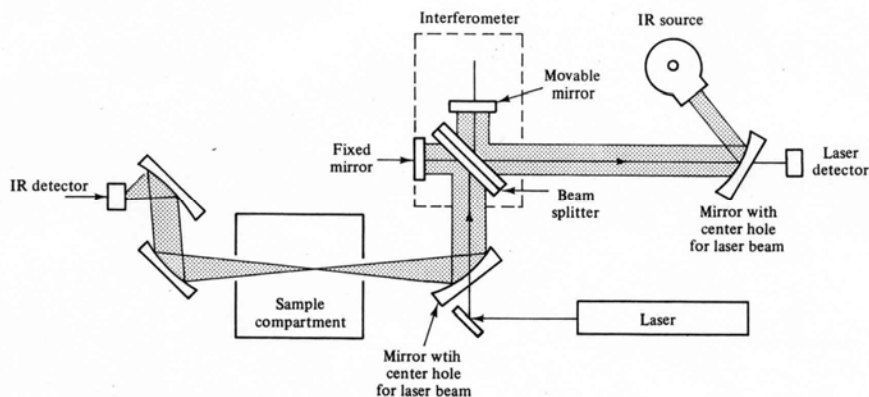
■ Photoconductive

- semiconductors (e.g., Ge, Si, CdSe, PbS, CdS, etc.)
- resistance decreases with increased photon flux
(due to promotion of electrons to conduction band)
- ***slow (ms) and limited to visible and NIR unless:***
 - Cooled to N₂(l) temps (μs response in IR)
- **MCT (Mercury/Cadmium Telluride) Detector**
 - cooled with liquid nitrogen
 - about 100x more sensitive than TGS detector
 - expensive* (k\$), limited wavelength coverage, popular option

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IR Instruments

- *Almost exclusively based on FT-interferometry:*



FT-IR Advantages

- ✓ **S/N Enhancement & Rapid Scanning**
 - * Due to Fellgett's and Jacquinot's Advantages
- ✓ **Precise Wavenumber Calibration**
 - * Due to laser reference
 - * Facilitates:
 - ➔ Signal averaging
 - ➔ Spectral Subtraction
 - ➔ Computer-based spectral I.D.
- ✓ **High-Resolution Capability**
- ✓ **No Stray Radiation Problems**
 - * Each IR frequency has a unique modulation frequency