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)**

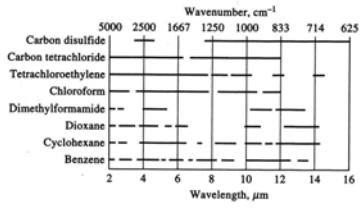
Sample Cells

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

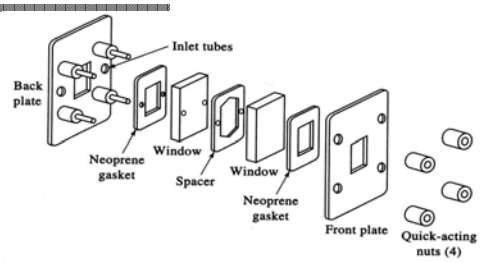
- **Solids** (particulates should be *smaller* than λ_{IR})
  - -mix with KBr and press into a pellet
  - ***OR***
  - -grind with *heavy hydrocarbon oil* (Nujol®) or *halogenated polymer* (Fluorolube®)
  - -view resulting mull as a film between salt plates
- **Gases**
  - -use *long pathlength* (up to 1000 meters!) to get adequate sensitivity

Solution Samples

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



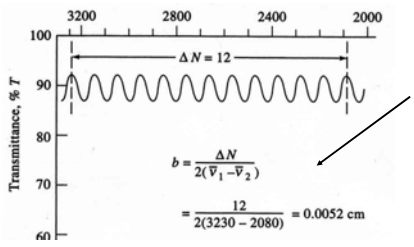
More Solution Samples



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

Determining Cell Pathlength

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



Determination of the distance between the salt plates

Detectors

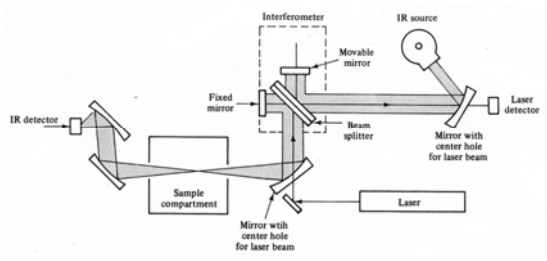
- **Thermal** - based on temperature detection
  - **Thermocouple**
    - poor sensitivity
    - *slow* (>ms response time) - ***not suitable for FT-IR***
  - **TGS (Triglycine Sulfate)**
    - based on *pyroelectric effect* (temperature dependant capacitance)
    - *fast enough for FT-IR* (but less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

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 $N_2(l)$ temps (μs response in IR)
  - **MCT** (Mercury/Cadmium Telluride) **Detector**
    -cooled with liquid nitrogen
    -about 100x more sensistive than TGS detector
    -*expensive* (k$), limited wavelength coverage, popular option

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