Chemistry 3108
Physical Chemistry Laboratory II
Department of Chemistry and Biochemistry
Texas Tech University

Notes for Experiment 35:
Raman Spectroscopy:
A. Vibrational Spectrum of CCl_4
B. Identification of Components in Unknown Sample

These notes are intended to supplement the textbook (pp. 385-393). Be sure to read the relevant pages in your textbook. Although much of the material in these notes was covered in lab lecture, there are points concerning the procedure and or apparatus that are specific to the Physical Chemistry Laboratory.

1. This is a two part lab.

   a) In the first part of the lab you will use Raman spectroscopy to study the vibrational spectrum of liquid CCl_4. Knowledge of the nature of the $\tilde{n}_1$, $\tilde{n}_2$, $\tilde{n}_3$, and $\tilde{n}_4$ normal modes of CCl_4 (see Table 1) will allow you to assign the peaks in the Raman spectrum of CCl_4. The valence-model force model will be used to determine the force constants k and k_δ/l^2 from the wavenumbers of the Raman peaks. Note that in these eqs 12-15, the ν_i are in units of s^{-1}. So you will have to do a unit conversion from cm^{-1} to s^{-1}.

   b) In the second part of this lab, you will use Raman spectroscopy to determine the components of an unknown sample. You will take Raman spectra of 5 solvents. The unknown sample will be a mixture comprising two or three of these solvents. By comparing peaks of the Raman spectrum of your unknown to the Raman spectra of the neat solvents, you will deduce the identity of the components that make your unknown.
2. Raman spectra will obtained by using a DeltaNu Advantage 200 Raman Spectrometer. The manuals for this instrument can be found the website:
   http://www3.tltc.ttu.edu/quitevis/courses/pchem/chem3108s06/Manuals.htm
   Read these manuals before coming to class.
3. To determine whether a Raman line corresponds to a totally symmetric vibrational mode or not totally symmetric one must measure the depolarization ratio $I_{perpendicular}/I_{parallel}$ for that line. The quantities $I_{perpendicular}$ and $I_{parallel}$ are obtained by measuring intensities of the Raman line for light scattering with polarization perpendicular and parallel to the polarization of the exciting light. The Advantage 200 determines whether the Raman line is totally symmetric from the difference $I_{perpendicular} - I_{parallel}$. A Raman line is totally symmetric of it is a negative peak in the difference spectrum.