EXCESS THERMODYNAMIC FUNCTIONS VIA LASER LIGHT SCATTERING, REFRACTOMETRY, AND DENSITOMETRY

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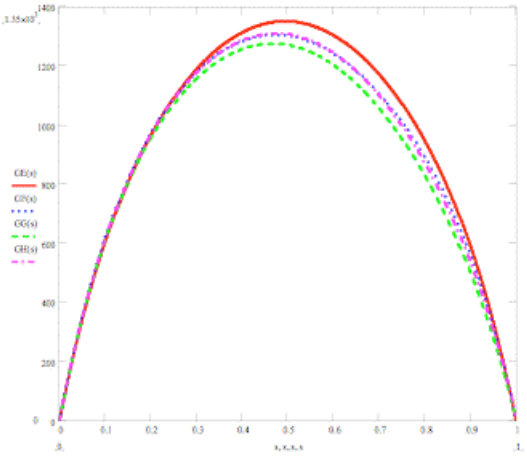
When light passes through a liquid or liquid mixture, photons are scattered and depolarized. By measuring the intensity and polarization of scattered light, refractive index, and density of a binary liquid mixture across a range of mole fractions, we can obtain Excess Gibbs Energies of Mixing (G^E), Excess Volumes of Mixing (V^E), and isothermal compressibilities (κ_T) for our mixtures. Although the method has proven difficult for studying systems with small differences in refractive index, the ease of auxiliary measurements and the ability to study mixtures at room temperature render the light scattering method a powerful tool for the quick study of non-ideal molecular interactions in liquid mixtures.



Cyclohexanol + hexane, heptane, octane, nonane at 25°C

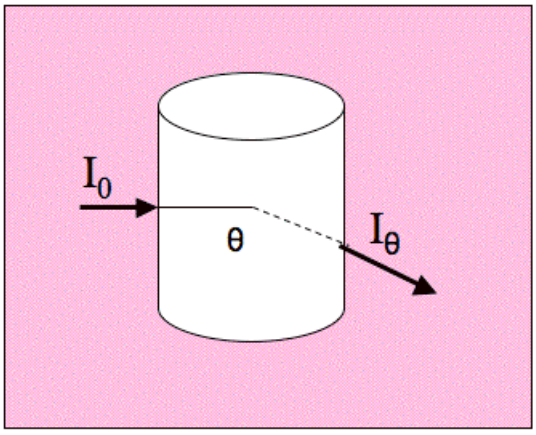


Diagram illustrating light being scattered by a sample.

After using Mathcad software to update our GE model and reanalyzing raw data taken by previous students, **undergraduate student Mark Cyffka '10** studied the potential of the laser light scattering method in the systems DMSO + H_2O and CH_3COCH_3 + $CHCl_3$, both of which are known to exhibit negative GE values. Later, cyclic and linear alcohols and linear alkanes were investigated, with results indicating that the introduction of non-polar alkanes to the hydrogen bond network in alcohol-rich mixtures is more disruptive that the introduction of alcohol to alkane-rich mixtures.

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