

Percent Ethanol in Water Determination Using Raman Spectroscopy

Purpose	In this experiment Raman spectra will be collected of several solutions containing different ratios of ethanol to water. A linear relationship between the area of the fingerprint ethanol peak and the solution ratio will be established. The ethanol/water ratio of unknown solutions can be determined using this linear relationship.
References	1 Galloway, D.B.; Ciolkowski, E.L.; Dallinger, R.F. <i>J Chem. Educ.</i> 1992 , <i>69</i> , 79-83.
Apparatus	DeltaNu Raman Spectrometer and accessories 1 mL glass vials Pipettes
Chemicals	Water Ethanol
Theory	Raman spectroscopy can be a valuable tool in analytical chemistry. A plot of the area of the 883 cm^{-1} ethanol band representative of symmetric CCO stretching versus the percent weight of ethanol in water gives a linear calibration curve. This linear relationship can be used to determine the percent ratio of ethanol to water in unknown solutions.
Procedure	<p>To begin this experiment, make solutions of 5%, 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, and 100%, by weight, ethanol in water. Next, obtain a Raman spectrum, at an integration time of ten seconds, of each of the eleven solutions. For each spectrum, integrate the area under the 883 cm^{-1} ethanol band representative of symmetric CCO stretching. Construct a plot of the peak area versus the weight % ethanol in solution. Determine the slope and the intercept of the line, as well as the R^2 value of the trend line. This information may be used to predict the weight % ethanol in solution of unknown samples.</p> <p>Unknown Determination: Obtain a vial containing an unknown weight percent concentration of ethanol in water. Take a Raman spectrum of the sample and integrate the area of the peak as before.</p>
Treatment	Using the area of the 883 cm^{-1} ethanol peak, determine the weight % of ethanol in the unknown sample.
Questions	<ol style="list-style-type: none">1) What was the weight % of ethanol in the unknown sample?2) Comment on the accuracy and the precision of the answer to question 1 taking into consideration the R^2 value of the trend line in the graph.