USE OF ATR AND CIRCLE CELL IN THE FTIR SPECTRA OF POLYMERS AND MICELLES

John D. Gilbertson and Arlen Viste
Department of Chemistry, Augustana College
Sioux Falls, SD 57197

ABSTRACT

The purpose of this research was to work out procedures for analysis of polymers in FTIR (Fourier transform infrared spectroscopy) using Attenuated Total Reflectance (ATR accessory), and to investigate micelles in FTIR utilizing Cylindrical Internal Reflectance (Circle Cell), in the context of undergraduate laboratory work.

Keywords

Attenuated Total Reflectance, Cylindrical Internal Reflectance, FTIR, polymers, micelles

INTRODUCTION

The purpose of this research was to work out procedures for analysis of polymers in FTIR (Fourier transform infrared spectroscopy) using Attenuated Total Reflectance (ATR accessory), and to investigate micelles in FTIR utilizing Cylindrical Internal Reflectance (Circle Cell), in the undergraduate laboratory. The ATR method involved internal reflections of an infrared beam within a crystal, with only slight penetration of the surface of a sample on the face of the crystal.

METHODS

The ATR crystal used was KRS-5, consisting of TlBr and TlI. With this surface analysis method, the polymer sample used could be thicker than the thin films generally needed in transmission methods of FTIR. The Circle Cell also involved internal reflections, providing an FTIR spectrum of the liquid or solution at its interface with the ZnSe rod. (Griffith, 1986). This was used to explore FTIR spectra of micelles. The instrument used was an IBM Instruments IR32 FTIR.

RESULTS AND DISCUSSION

An example of ATR on this instrument was this spectrum of a polypropylene melt.

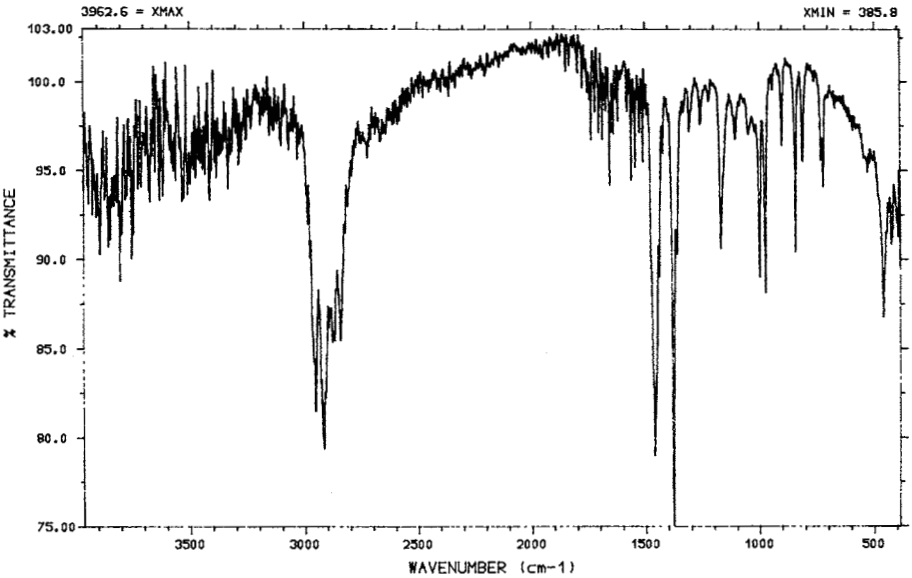

Figure 1. FTIR spectrum of a polypropylene melt using ATR

The desired result was found, in that this spectrum was matched successfully with a search of our polymer library on the FTIR.

The Circle Cell was used to explore FTIR spectra of micelles. The critical micelle concentration (CMC) was of particular interest. (Kabanov, 1999). Plots of physical properties such as conductance often show a break in slope at the CMC. (Ross, 1988). One of the systems explored here was sodium stearate in water.

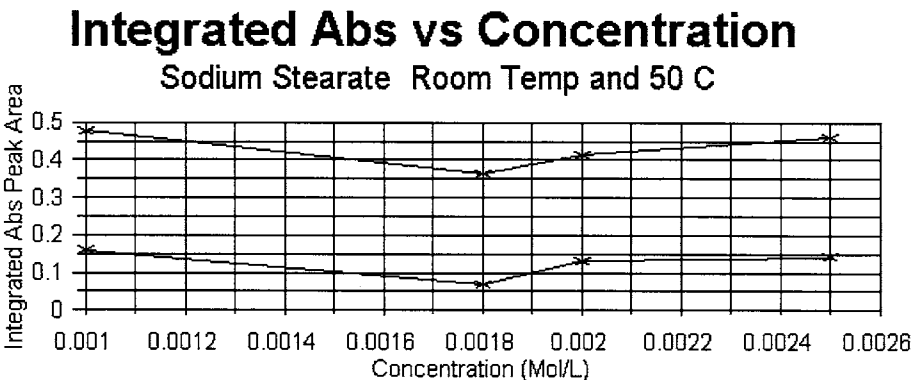

Figure 2. FTIR of sodium stearate micelles observed with Circle cell
Upper: 50°C; Lower: room temp

The result of this investigation with the Circle cell was that a break in the integrated absorbance of the C-H region occurred in the vicinity of the CMC for the system sodium stearate - water.

CONCLUSION

ATR served as a good method for determining the FTIR spectrum of a solid polymer sample. It did nor require an extremely thin layer of sample, as in the case of transmission methods of FTIR. The Circle Cell served well to measure the FTIR spectrum of surfactant materials in water. The CMC was reflected in a plot of the integrated absorbance versus concentration. Ordinary sodium chloride cells would not have been compatible with water.

LITERATURE CITED

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ACKNOWLEDGMENTS

Most of this research was carried out as part of the Summer Science Institute, during Summer 1998, at Augustana College.