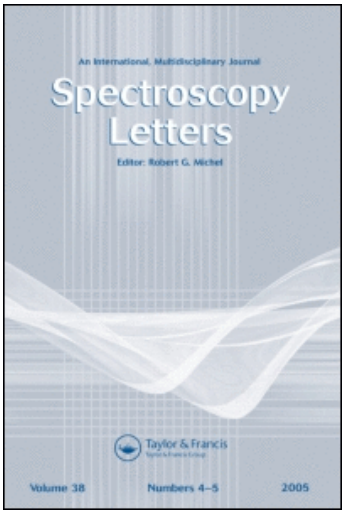

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Absorption in the ν_3 Band of UF_6 Dissolved in Solid Xenon

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ABSORPTION IN THE ν_3 BAND OF UF_6 DISSOLVED IN SOLID XENON*

by

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ABSTRACT

The ν_3 band of UF_6 isolated in solid xenon is shown to consist of a single sharp spectral feature.

Typically, an absorption band of UF_6 trapped in a deposition matrix is split into several components. In the spectrum reported by Paine et al.[1] the ν_3 band of UF_6 trapped in an argon deposition matrix at 8.2 K is split into at least five components. The spectra of Catalano et al.[2] show the ν_3 band of UF_6 trapped in N_2, Ar, and CO matrices to be split into 2-3 spectrally resolved features. This splitting of the absorption of a given band may be caused by agglomeration of the UF_6 molecules or by occupation of different lattice sites by the UF_6.

It is the purpose of this work to present absorption spectra of the ν_3 band of UF_6 dissolved in solid xenon. These spectra differ significantly from the spectra reported for UF_6 dissolved in deposition matrices.

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Solutions of UF_6 in solid xenon were produced by freezing liquid solutions. The method has been described in detail elsewhere.[3,4,5] Wavenumbers cited here should be within ±0.05 cm^{-1} of the true wavenumbers.

The ν_3 band of UF_6 dissolved in solid xenon is shown in Fig. 1. The band consists of a single feature whose position and spectral width depend significantly on sample temperature. The effect of temperature on bandwidth and position is not quantitatively understood.

The undulations in the baseline (near 100% transmission) in Fig. 1 are caused by an etalon in the cell windows. This etalon extends for a considerable range on either side of the ν_3 band, and only small portions of the etalon patterns are shown. The etalon pattern is larger at the lower temperature in Fig. 1 because cooling causes the solid sample to pull away from the windows; the index of refraction in the medium adjoining the cell windows decreases; the reflectivity of the interface increases; and the etalon pattern becomes more pronounced. A four-fold increase in UF_6 concentration does not affect the strength or period of this etalon pattern.[6]

A dramatic narrowing of the ν_3 band occurs between 173 and 80 K, and at 80 K the observed bandwidth (FWHM) is only 0.07 cm^{-1} wider than the instrumental resolution. This spectral width is much narrower than spectral widths (0.3-0.7 cm^{-1} wider than instrumental resolution) reported by Paine et al.[1] for the individual components of the ν_3 band of UF_6 trapped in a 1000:1 Ar:UF_6 matrix at ~10 K. Although the true spectral profile of the ν_3 band cannot be accurately inferred from the data shown in Fig. 1, it is clear that the spectral width of the ν_3 band is significantly narrower in solid xenon solution at 80 K than in the low temperature (4.2-10 K) deposition matrices studied to date.[1,2]

The spectra in Fig. 1 are free of the multiple-line structure normally found in deposition matrices. We presume that this difference occurs because samples produced by matrix deposition have been less uniform than the solid solutions. That is, the solid solutions apparently do not have the multiple

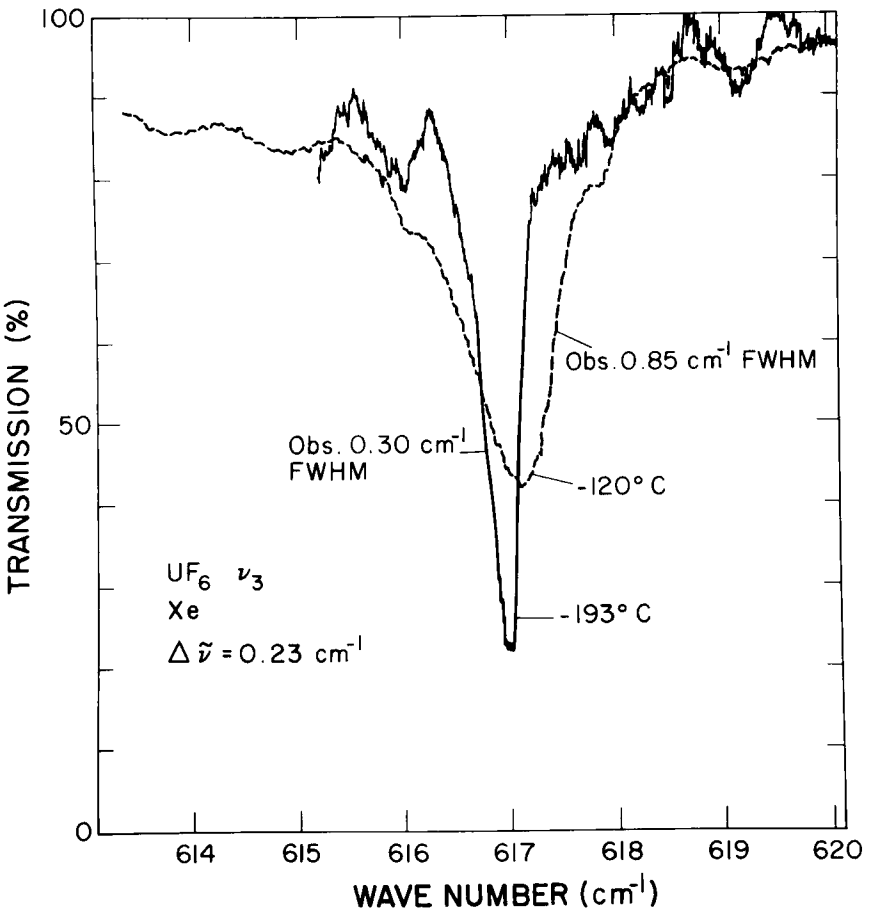

Fig. 1. Absorption in the ν_3 band of UF_6 dissolved in solid xenon. The optical pathlength is 1.27 cm. From an integrated absorption cross section of 10^{-16} cm^2-cm^{-1}/molecule and the spectrum at -120°C, UF_6 concentration is calculated to be about 7.3×10^{15} molecules/cm^{-3} (0.52 ppm). Spectra were measured with a 1-meter monochromator, and the instrumental resolution, $\Delta\tilde{\nu}$, is 0.23 cm^{-1}.

sites and UF_6 agglomerations that were present in the deposition matrices. The narrow bandwidths and single line observed for UF_6 in solid solutions are probably more characteristic of UF_6 isolated in solid xenon than are the broader, multiple bands reported for deposition matrices.

REFERENCES

1. R. T. Paine, R. S. McDowell, L. B. Asprey, and L. H. Jones, J. Chem. Phys. 64, 3081 (1976).

2. E. Catalano, E. L. Lee, and M. Schwab, UCRL-51888 (Lawrence Livermore National Laboratory, Livermore, California, August, 1975).

3. R. F. Holland, W. B. Maier II, S. M. Freund, and W. H. Beattie, J. Chem. Phys. (In press, 1983).

4. W. B. Maier II, R. F. Holland, S. M. Freund, and W. H. Beattie, J. Chem. Phys. 72, 264 (1980).

5. W. B. Maier II and R. F. Holland, J. Chem. Phys. 72, 6661 (1980).

6. Changing the cell windows altered the period of the etalon pattern.

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