

INELASTIC LIGHT SCATTERING PROCESSES

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ABSTRACT

Five different inelastic light scattering processes will be denoted by ordinary Raman scattering (ORS), resonance Raman scattering (RRS), off-resonance fluorescence (ORF), resonance fluorescence (RF), and broad fluorescence (BF). A distinction between fluorescence (including ORF and RF) and Raman scattering (including ORS and RRS) will be made in terms of the number of intermediate molecular states which contribute significantly to the scattered amplitude, and not in terms of excited state lifetimes or virtual versus real processes.

The theory of these processes will be reviewed, including the effects of pressure, laser wavelength, and laser spectral distribution on the scattered intensity.

The application of these processes to the remote sensing of atmospheric pollutants will be discussed briefly. It will be pointed out that the poor sensitivity of the ORS technique cannot be increased by going toward resonance without also compromising the advantages it has over the RF technique.

Experimental results on inelastic light scattering from I_2 vapor will be presented. As a single longitudinal mode 5145 Å argon-ion laser line was tuned away from an I_2 absorption line, the scattering was observed to change from RF to ORF. The basis of the distinction is the different pressure dependence of the scattered intensity. Nearly three orders of magnitude enhancement of the scattered intensity was measured in going from ORF to RF. Forty-seven overtones were observed and their relative intensities measured. The ORF cross section of I_2 compared to the ORS cross section of N_2 was found to be 3×10^6 , with I_2 at its room temperature vapor pressure.

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