STIMULATED RAMAN SCATTERING IN DIMETHYLAMINE

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Stimulated Raman scattering in aromatic substances has been studied thoroughly [1, 2].

We report here an attempt to obtain stimulated Raman scattering in one of the aliphatic–aromatic amines – dimethylamine. Substances of this group undergo a rapid oxidation and condensation under the influence of light [3], so we took special measures to seal the vessel and protect the substance from light. We used technical-grade dimethylamine purified by repeated distillation.

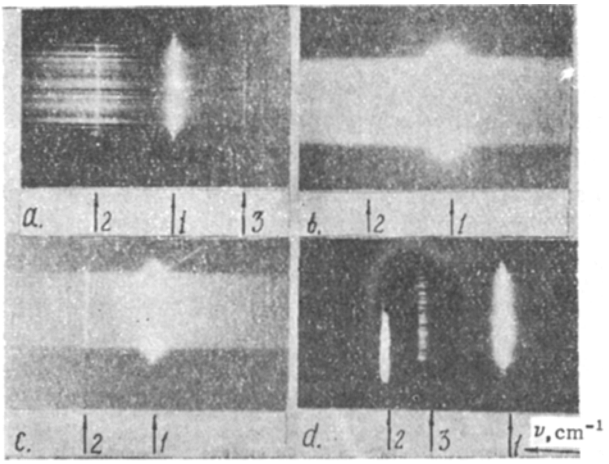

Fig. 1. a: Radiation of ruby laser, ν_L = 14,403 cm^{-1} (λ_L = 6943 Å); 2) anti-Stokes component, ν_a = 15,385 cm^{-1} (λ_a = 6500 Å) for Ω^1_{+1} = 982 cm^{-1}; 3) Stokes component, ν_S = 13,227 cm^{-1} (λ_S = 7560 A) for Ω^2_{-1} = 1176 cm^{-1}. The intensity ratio was I_a/I_S = 10. The pumping energy for the GOR-100m laser was E = 7.5 kJ. The spectrometer slit was t = 0.01 mm wide. The dimethylamine was studied immediately after purification. b: 1) ν_L = 14,403 cm^{-1}; 2) anti-Stokes component split into three components [a very clearly defined, intense component at ν_{a1} = 15,389 cm^{-1}, a blurred component at ν_{a2} = 15,385 cm^{-1}, and a clearly defined but faint component at ν_{a3} = 15,372 cm^{-1}]. The pumping energy was E = 9.0 kJ, and the spectrometer slit width was t = 0.4 mm. c: one anti-Stokes component, ν_a = 15,385 cm^{-1}, obtained after an additional distillation of the dimethylamine. E = 6.7 kJ, t = 0.05 mm. d: lines of 1) the ruby laser; 3) a gas laser, λ = 6328 Å; and 2) the anti-Stokes component, λ = 6500 Å.

In the experimental apparatus (Fig. 2), a standard GOR-100m ruby laser (2, 4, 5) is used as a master oscillator, KS-19 filters (3, 6) modulate the radiation and suppress the radiation from the laser pumping lamps, and F = 300 mm lenses (7, 9) focus the radiation on the center of the cuvette (8) and on the spectrometer slit (10). The pulses are monitored by an FEU-28 photomultiplier (1) and an OK-17M oscilloscope (11); a pulse contains about 10 peaks. After the radiation passes through the ISP-51 spectrometer, its spectrum is recorded on Orwo-27 photographic film, whose high spectral sensitivity in the range λ = 0.4-1.0 μ has been checked in experiments involving stimulated Raman scattering in nitrobenzene [4].

The stimulated Raman scattering was excited at two frequencies: Ω^1 = 982 and Ω^2 = 1174 cm^{-1}. The anti-Stokes component was excited at the natural frequency Ω^1_{+1}, while the Stokes component was excited only at frequencies Ω^2_{-1}. The anti-Stokes component was always an order of magnitude or more intense than the Stokes component, and in some cases the Stokes component was missing altogether. The accompanying figures in Fig. 1 illustrate the results.

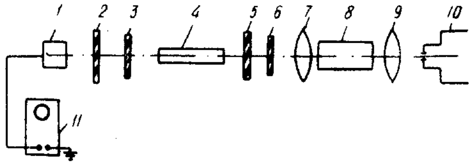

Fig. 2

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The anti-Stokes component disappeared after 4-5 operations, while the Stokes component disappeared after 1-2 operations, so we can conclude that the composition of the substance is affected by the laser radiation. It was shown in [5] that the Stokes component (but not the anti-Stokes component) can split at a power level slightly above the threshold. An interesting feature in addition to the much greater intensity of the anti-Stokes component than that of the Stokes component for the substance in its normal state is the absence of the Stokes component for the transition $\Omega^1 = 982\ \mathrm{cm}^{-1}$ and of the anti-Stokes component for $\Omega^2 = 1176\ \mathrm{cm}^{-1}$.

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