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3-ns pulse transmission in SF_2 buffered by C_5H_6OH and freon 502 at 10.6 μm*

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The primary motivation for nanosecond pulse transmission experiments has been the use of SF_6-based saturable absorbers for wideband gas isolators in laser systems for the fusion. This is our first investigation of the mixture SF_6, C_2H_5OH and freon 502, and therefore the results obtained indicate only the directions for further investigations.

Transmission of the SF_6 buffered by other gases was measured by many authors [1–3]. Recently, the results of measurements on nanosecond time scale have been presented in paper [4]. These measurements, however, concerned SF_6 buffered by nitrogen and noble gases in order to present the possibilities of the enhancement of the contrast ratio of the passing pulse.

We have tried to measure the transmission characteristics of the SF_6 buffered by C_2H_5OH and freon 502. In this mixture the SF_6 is a saturable element at 10.6 μm and ethyl alkohol with freon are used to quench parasitics on the residual generation spectrum of CO_2 molecule. The absorption spectra of SF_6, C_2H_5OH and freon 502 are presented in Figs. 1a–c, respectively, the summary spectrum of the mixture being given in Fig. 1d. In these figures we can see that a relatively deep hole in the transmission spectrum is in the neighbourhood of the maximum of the *R* branch, 10.4 μm band gain spectrum. The weak pressure dependence of the absorption spectrum width of the freon 502 requires the elimination of this hole by increasing the SF_6 pressure.

The transmission characteristics against the input energy density have been measured on the nanosecond scale in the experimental set-up shown in Fig. 2. Results of the measurements are presented in Figs. 3 and 4. Transmission characteristics of the pure SF_6 (Fig. 3) resemble the ones in [4]. From Figures 3 and 4 it follows that 31 hPa of C_2H_5OH and 101 hPa of the freon act as 20 hPa of the pure SF_6. The exact analysis of the behaviour of such mixture cannot be performed without some additional measurements, due to the uncertainties concerning the mechanisms of the absorption by the SF_6 molecule and to the lack of relaxation times data. That is caused by strong dependence

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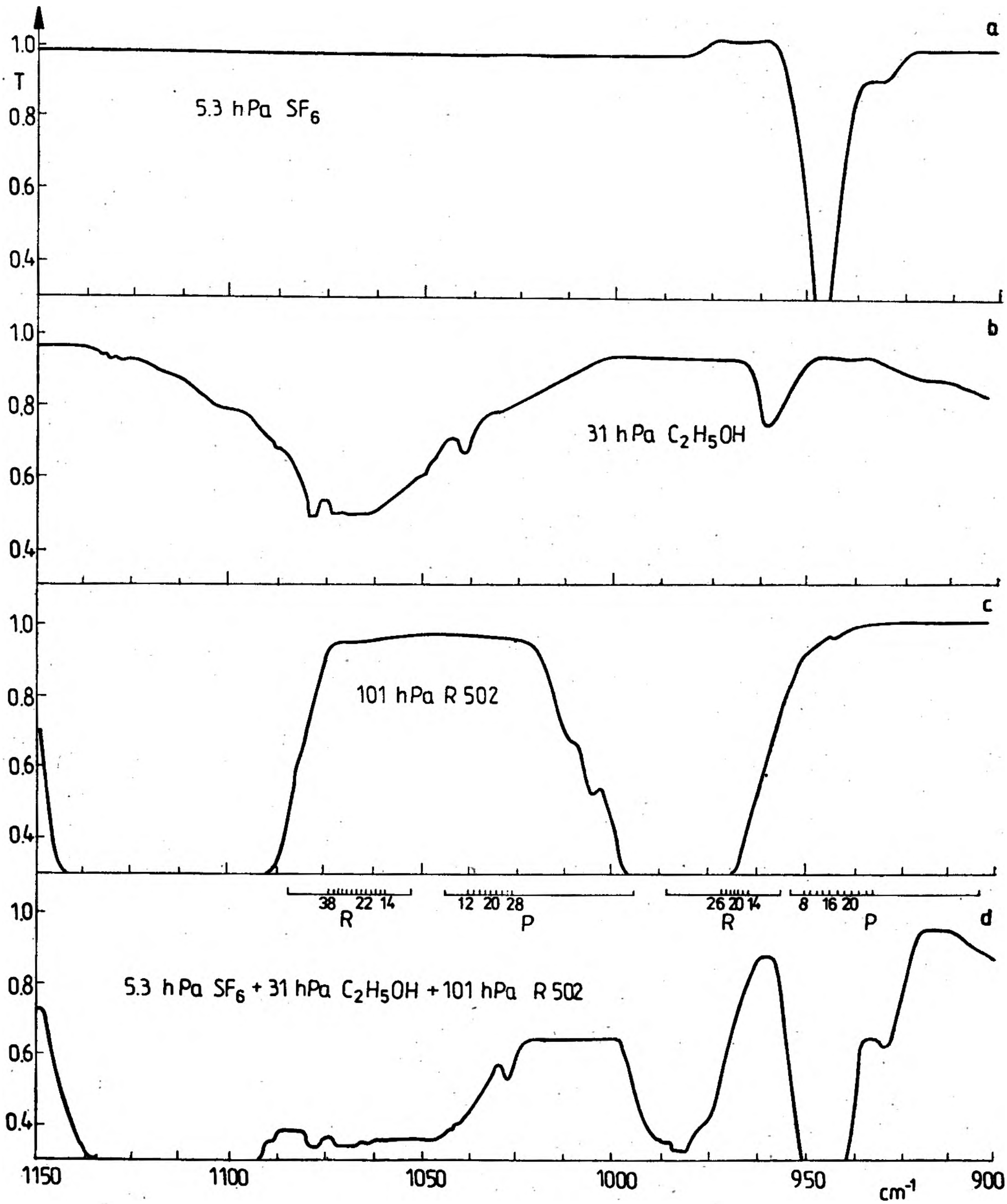

Fig. 1. Small-signal transmission spectra for pure SF_6 (a), ethyl alcohol (b), freon 502 (c) and summary mixture (d)

of the level excitation and relaxation times on both the input energy density and anharmonicity in the SF_6 molecule.

Finally, let us make a mention about the errors committed in our measurements. They were chiefly made while defining the input and output energy densities because of very small changes in the propagation direction, and the subsequent averaging at the input diaphragm aperture. The changes in errors were also caused by varying sensitivity of the energy meter-oscilloscope system.

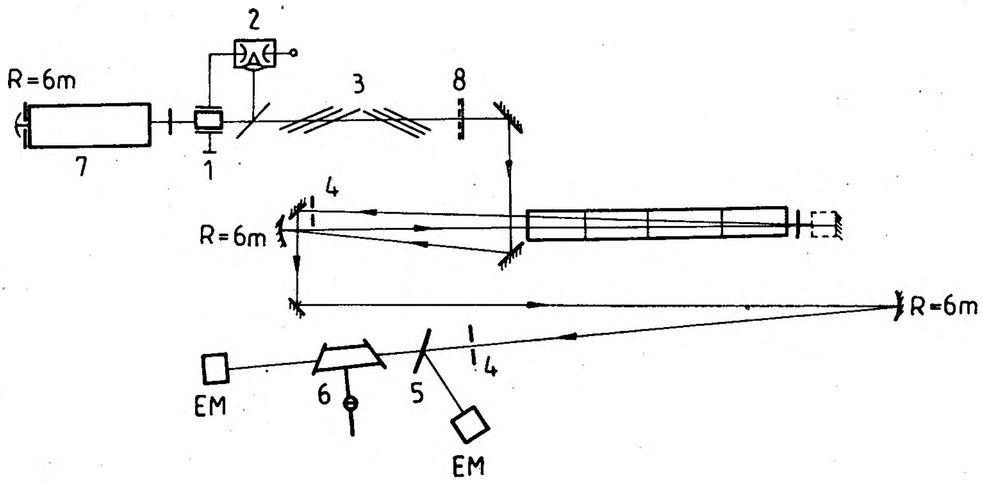

Fig. 2. Experimental set-up: 1 – Pockel's cell, 2 – laser spark gap, 3 – analyser, 4 – diaphragm, 5 – beam splitter, 6 – absorber, 7 – TEA CO_2 hybrid laser, 8 – attenuator, EM – energy meter

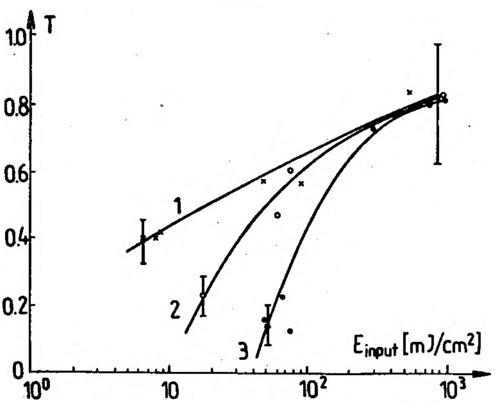

Fig. 3. 3-ns pulse transmission characteristics for pure SF_6: 1 – 5.3 hPa SF_6, 2 – 19.2 hPa SF_6

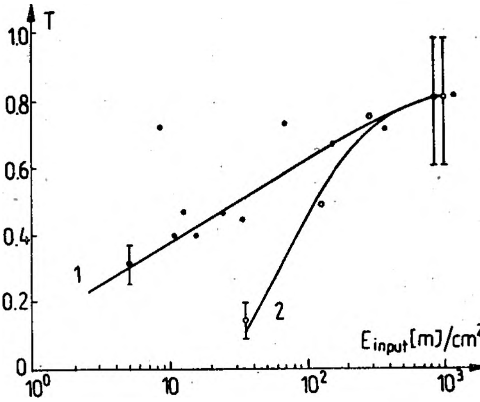

Fig. 4. 3-ns pulse transmission characteristics for buffered sulfur hexafluoride: 1 – 5.3 hPa SF_6, 41.8 hPa C_2H_5OH, 2 – 53 hPa SF_6, 75 hPa C_2H_5OH, 3 – 53 hPa SF_6, 31 hPa C_2H_5OH, 101 hPa, R 502

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