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## PARAMETRIC GENERATION WITH CdSe CRYSTAL PUMPED BY $CaF_2:Dy^{2+}$ LASER

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Coherent radiation sources that can be tuned in range from 0.5 to 3.7 μ have by now been produced on the basis of parametric generation (cf., e.g., [1]). However, the range from 3 to 10 μ, which has not yet been mastered, is of great interest for a large number of physical investigations, such as laser photochemistry, and molecular spectroscopy.

We have obtained, for the first time, parametric generation with the semiconducting crystal CdSe. The wavelengths of the parametric radiation were 3.37 and 7.86 μ.

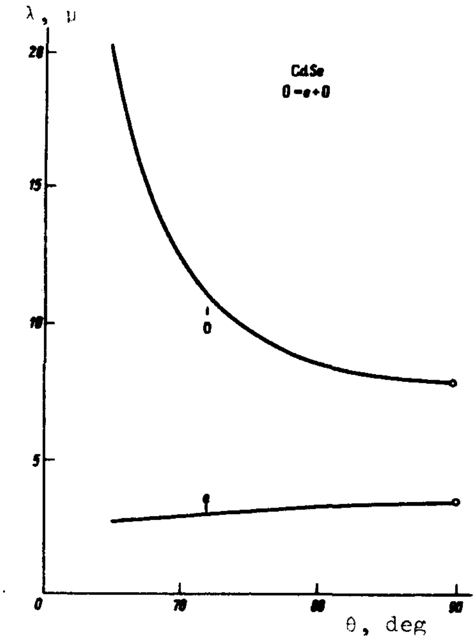
CdSe is a uniaxial positive crystal ($n_e > n_o$), belongs to the point symmetry group 6mm, is transparent in the wavelength range from 0.75 to 20 μ, is of high optical quality, and its absorption coefficient in the transparency region does not exceed 0.01 $cm^{-1}$.

The only parametric interaction possible in the CdSe crystal is of the type o = e + o. In this case the effective nonlinear coefficient is $d_{eff} = 2d_{15}\sin\theta$, where θ is the angle between the wave vector of the pump radiation and the optical axis of the crystal, and $d_{15}$ is the nonlinear optical coefficient with value $0.74 \times 10^{-7}$ cgs units [2]. From the data on the refractive indices [3, 4] it follows that CdSe has 90° synchronism, and the maximum range of tuning of the parametric frequencies is obtained when the pumping wavelength is ~2.5 μ.

The pumping source was a Q-switched $CaF_2:Dy^{2+}$ laser with emission wavelength 2.36 μ operating with a repetition frequency 1 Hz. The Q switching was with a Pockels cell using an $LiNbO_3$ crystal [5, 6] or with a rotating prism, in analogy with [7], and the generation consisted of pulses of 30 - 40 nsec duration with peak power 10 MW.

The resonator of the parametric generator was made up of two plane-parallel dielectric mirrors coated on a fluorite substrate. The effective feedback in the resonator was produced at only one parametric wavelength λ = 3.37 μ, for which the reflection coefficient exceeded 99%. The transmission of the mirrors at the other parametric wavelength, λ = 7.86 μ and at the pump wavelength λ = 2.36 μ was 80 and 85%, respectively. The CdSe crystal was 2.5 cm long, the plane-parallel end faces were cut at an angle 90° to the optical axis.

We observed the parametric-radiation signal when the pump power density exceeded the threshold value 3 $MW/cm^2$. In our experiment we registered the longwave parametric radiation, whose wavelength was determined with an IKM-1 monochromator to be 7.86 ± 0.02 μ. The figure shows the calculated tuning curves for the parametric radiation in CdSe pumped at a wavelength 2.36 μ. We used in the calculation the values of the parametric-generation wavelengths for 90° synchronism. The parametric radiation power at 7.86 μ was ~5 kW at a pump power close to threshold (~1 MW), corresponding to the conversion coefficient 0.5%. Damage to the dielectric mirrors of the parametric generator did not make it possible to raise the pump power density noticeably above the threshold value. The CdSe crystal exhibited much better endurance to the action of the pump than




Tuning curves for parametric radiation in CdSe pumped at 2.36 μ. θ is the angle between the pump wave vector and the optical axis of the crystal. The symbols o and e denote the parametric waves of the ordinary and extraordinary polarizations.

the mirrors. The threshold power density required to damage the polished end faces of the crystal was 30 $MW/cm^2$ at 2.36 μ for a pulse duration 30 - 40 nsec. No sign of damage in the interior of the CdSe was observed.

The presence of 90° synchronism and low internal losses make the CdSe crystal a promising material for parametric generators in the infrared band, with continuous pumping. Estimates of the threshold power from a cw $CaF_2:Dy^{2+}$ laser at optimal focusing yield a value of 150 W for a resonator with feedback at one parametric frequency and 2 W for a resonator with feedback at both parametric frequencies.

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## CROSS SECTIONS FOR ELASTIC SCATTERING OF SLOW POSITRONS IN INERT GASES

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Observation of a component of non-exponential type, the so-called "shoulder," on the time spectra of positron annihilation in inert gases [1, 2], uncovers new possibilities of experimentally estimating the cross sections for the scattering of slow positrons ($\lesssim$10 eV by atoms and molecules). In particular, it is possible to obtain the elastic cross sections of positrons in binary mixtures of inert gases. We have measured for this purpose the reduction in the duration of the "shoulder" following addition of lighter inert gases to xenon and argon (Figs. 1 and 2).

It is assumed that the "shoulder" duration $\underline{t}$ determines for the given gas at a density n ($cm^{-3}$) the time of elastic slowing down of the positrons from the positron production threshold to a sufficiently low energy at which the