The power efficiency of conversion into the fourth harmonic exceeded 50% of the second-harmonic efficiency, because the narrow stable line of the single-mode second harmonic radiation fell in the center of the frequency synchronism of the fourth harmonic. The results are summarized in the table.

| Harmonics | Power density MW/cm² | | | Interaction |
|---|---|---|---|---|
| | $P_2$ | $P_3$ | $P_4$ | |
| 2 | 100 | | | $K^{o}_{(\omega)} + K^{e}_{(\omega)} = K^{e}_{(2\omega)}$ |
| 3 | | 68 | | $K^{e}_{(\omega)} + K^{o}_{(2\omega)} = K^{e}_{(3\omega)}$ |
| 4 | | | 55 | $K^{o}_{(2\omega)} + K^{o}_{(2\omega)} = K^{e}_{(4\omega)}$ |

The power levels obtained in the UV band have made it possible to observe optical breakdown when the radiation was focused in air by a quartz lens of focal length 75 mm. The breakdown occurred starting with 7 MW for the fourth harmonic and starting with 13 MW for the third.

The main result of the investigation is that, insofar as we know, effective cascade conversion into the UV band was realized for the first time. The obtained UV power amounts to several dozen megawatts.

It is obvious that to increase further the efficiency of the cascade conversion and to increase the power of the obtained UV radiation, it is desirable to work at one spatial and frequency mode of the $TEM_{00}$ type, so as to prevent local damage to the crystals. It is also obvious that the described system is useful for obtaining a high-power fifth harmonic of neodymium radiation, and also for effective generation of the second harmonic of neodymium with lithium niobate, which also has a large frequency dispersion of the synchronism [6].

In conclusion, the authors thank S.A. Akhmanov, A.G. Ershov, and V.G. Dmitriev for a number of useful discussions.

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## HYPERFINE MAGNETIC FIELD FOR $Sn^{119}$ IMPURITY ATOMS IN FERROMAGNETIC TERBIUM

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Submitted 8 January 1971
ZhETF Pis. Red. 13, No. 4, 192 - 194 (20 February 1971)

The magnetic hyperfine fields have been measured by now for many impurity atoms in ferromagnetic 3d matrices (Fe, Co, Ni). At the same time, data on the magnetic fields at the nuclei of impurity atoms in rare-earth ferromagnetic

metals are very scanty. Such data would be of undoubted interest for the purpose of determining the nature of the hyperfine interaction and the character of the polarization of the conduction electrons in rare-earth metals.

We have measured the hyperfine magnetic fields for Sn impurity atoms in Tb and Gd matrices with the aid of the Mossbauer effect on $Sn^{119}$ nuclei. Solid solutions of Sn (0.6 at.%), enriched to 86.9% with $Sn^{119}$, in Tb and Gd were prefered by melting in an arc furnace in an argon atmosphere, followed by quenching. The metals Tb and Gd were procured from the State Rare-metals Institute and were 99.80 and 99.60% pure, respectively. The absorbers for the Mossbauer experiments were prepared from filings of the alloys, which were then deposited on a beryllium substrate. The $\gamma$-quantum source was $BaSnO_3$ containing the isotope $Sn^{119m}$. The measurements were made with an electrodynamic spectrometer with an NTA-512 multichannel analyzer.

For the Sn-Tb alloy, the Mossbauer absorption spectra were measured at 4.2, 78, 85, 207, and 217°K. The absorption spectrum for 78°K is shown in Fig. 1. The temperature dependence of the hyperfine field (Fig. 2) agrees with the Brillouin curve for I = 6, i.e., it is close to the temperature dependence of the matrix magnetization. The hyperfine field for Sn in Tb at liquid-helium temperature is H(Sn) = (241 ± 8) kOe.

Similar measurements were made for the Gd-Sn system (0.5 at.%). The result is in good agreement with the data of [1].

The hyperfine fields have by now been measured for Sn impurity atoms in three rare-earth ferromagnetic matrices: Gd [1], Er [2], and Tb (present work).

At a temperature close to 0°K, the hyperfine fields in these matrices are equal to 329, 124, and 341 kOe, respectively. It is easy to note that the ratio of the hyperfine field to the projection of the spin of the rare-earth ion on its total angular momentum (g - 1)I is approximately constant. Assuming that in the three matrices in question the rare-earth ions are in a state $3^+$, we obtain for the ratio H/(g - 1)I the values 94, 83, and 80, respectively. If the polarization of the conduction electrons in the rare-earth metals is assumed to be determined by the spin part of the magnetic moment of the rare-earth ion, then this result can be explained in a natural fashion as being due

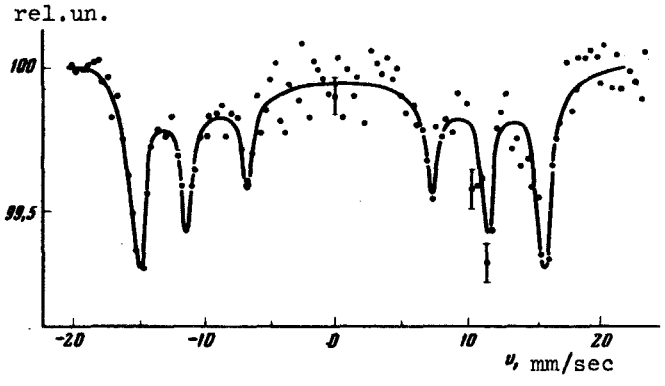


Fig. 1. Spectrum of resonant $\gamma$-quantum absorption by $Sn^{119}$ impurity atoms in Tb, measured at 78°K. Abscissas - velocity of $\gamma$-quantum source, ordinates - intensity of the quantum flux in relative units.

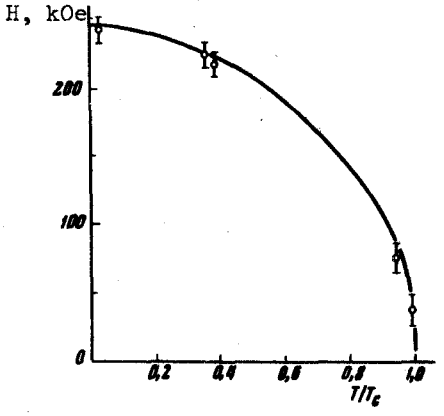


Fig. 2. Temperature dependence of the hyperfine magnetic field for Sn impurity atom in metallic Tb. Solid curve - Brillouin curve for I = 6.

to the fact that the degree of polarization of the conduction electrons, per unit spin magnetic moment, is the same and the hyperfine field for the Sn impurity atoms is proportional, in first approximation, to this polarization.

The authors thank N.I. Moreva for preparing the alloy and N.N. Delyagin for a discussion of the results.

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## EFFECT OF OPTICAL ORIENTATION OF ELECTRON SPINS IN A GaAs CRYSTAL

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ZhETF Pis. Red. 13 No. 4, 195 - 197 (20 February 1971)

The electron spins in the conduction band of a crystal can be oriented with circularly polarized light. The occurrence of such an orientation in cubic crystals, for example, is connected with the difference between the probabilities of the $^4\Gamma_8 \rightarrow {}^2\Gamma_6$ interband transitions (Fig. 1) from the band of the heavy holes (I = 3/2) and the band of the light holes (I = 1/2). Thus, upon excitation with $\sigma^{\pm}$ light, the probabilities of the $\mp 3/2 \rightarrow \mp 1/2$ and $\mp 1/2 \rightarrow \pm 1/2$ transitions have a ratio 3:1 [1]. This leads to predominant orientation of the electron spins in a direction opposite to the angular momentum of the exciting light M. The maximum degree of orientation is $P_{max} = (n_- - n_+)/(n_- + n_+) = 50\%$, where $n_+$ and $n_-$ are the numbers of excited electrons with spins directed parallel and antiparallel to M. The first to observe the occurrence of such an orientation were Lampel [2], by means of the signal of nuclear resonance in silicon, and Parsons [3], by means of the polarization of luminescence in GaSb.

Observation of circular polarization of luminescence in the solid solution $Ga_xAl_{1-x}As$ was recently reported [4]. Both in [3] and in [4], the excitation was with monochromatic light near the point k = 0. We present below the results of an investigation of the spin-orientation effect observed in a GaAs crystal for a wide range of exciting-light wavelengths. The measurements were performed on a p-type crystal with a hole density $2 \times 10^{19}$ cm$^{-3}$. The degree of the spin orientation was measured by determining the degree of polarization ρ of the luminescence at λ = 8475 Å, in analogy with [3]. The effect was identified by the 180° reversal of the luminescence circular-polarization signal on going from $\sigma^-$ polarized light to $\sigma^+$ and vice versa. In addition, depolarization of the luminescence under the influence of the magnetic field was observed, resulting from the precession of the electron spins up to the instant of emission (in analogy the well-known Hanle effect in gases).

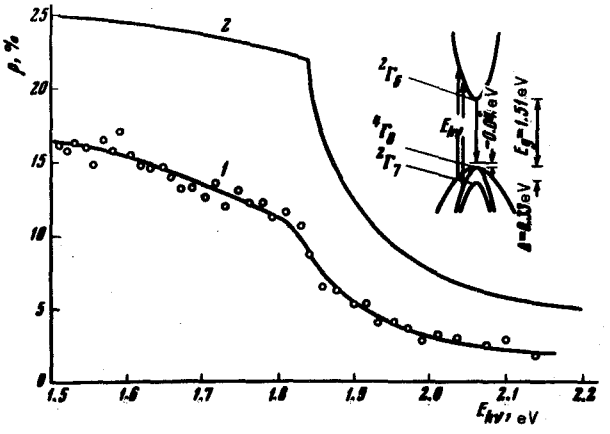


Fig. 1. Degree of polarization of luminescence in GaAs vs. energy of a photon of circularly-polarized exciting light: 1 - experimental curve; 2 - theoretical curve.