ΔV_B = 100 - 200 μV. The experimentally measured emf lies likewise in this range and increases linearly with the product $j_1 j_2$ (see Fig. 2).

The intrinsic Hall emf is given by [5]

$$\Delta V_H \approx \frac{\ln 4\mu_0 S}{4\pi ne} j^2, \qquad (2)$$

where S is the area of the cross section of the narrow part of the film. Substituting in (2) the same values of the parameters for the GaAs samples we obtain ΔV_H = 1 μV. We see that in the case of GaAs the "Bernoulli effect" plays the predominant role. For bismuth films at $j_1 = j_2 = 5\times10^4$ A/cm^2, assuming $m = 0.05\, m_0$ and taking into account the presence of two types of carrier (electrons and holes), we obtain respectively ΔV_B = 3 nV and ΔV_H = 320 nV. In contrast to GaAs, the Hall emf greatly predominates here. The calculated value of this emf is close to the observed one (Fig. 3).

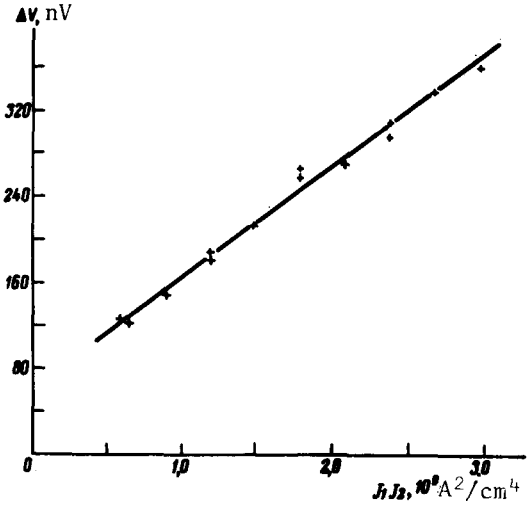

Fig. 3. The same as in Fig. 2, but for a Bi film, f_1 = 180 MHz.

We can thus state that configuration emf's of both types were observed in the described experiments, namely the "Bernoulli emf" in GaAs films and the intrinsic Hall emf in bismuth films.

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EFFECT OF REVERSIBLE PRESSURE DEPENDENCE OF X-RAY K LINES OF SMARIUM IN SmS

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A decrease in the energy of the $K\alpha_1$, $K\beta_1$, and $K\beta_{2,4}$ x-ray lines of samarium, by as much as one electron volt, was observed in SmS at pressures 6 — 9 kbar; this decrease vanished when the pressure was removed.

A reversible change in the dimensions of the crystal lattice of SmS ($\Delta v/v \approx 14\%$) was observed at pressures 6 — 8 kbar. No change took place in the lattice symmetry (of the NaCl type before and after the transition), and the phenomenon was therefore classified as an isomorphic phase transition analogous to the known transition of metallic cerium.

It is assumed [2] that under pressure the 4f electron (electrons) of the initially divalent samarium, with configuration $[Xe]4f^6 6S^2$ goes (go) over in part to a valent level, probably 5d. The configuration is then $[Xe]4f^{6-\eta}5d^{\eta}6S^2$, and the valence approaches three ($2 + \eta \approx 2.7$). The resultant 5d electrons produce metal-metal bonds in the SmS lattice. This model explains the observed change of volume and the appearance of metallic conductivity, and apparently also the almost complete vanishing of the magnetic moments localized at the samarium atoms [2].

It was shown in [3 - 5] that the decrease in the number of 4f electrons in chemical transformation of rare-earth elements leads to anomalously large characteristic shifts (energy decreases) of the x-ray K lines[1)]. Therefore if the model proposed for SmS is indeed realized, then one should expect a strong and reversible pressure dependence of the energy of the principal

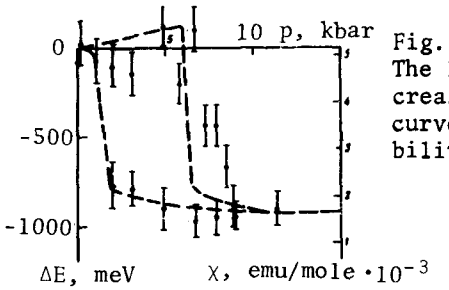

Fig. 1. Shift of $K\beta_1$ line of samarium in SmS vs. the pressure. The light and dark circles show the values obtained with increasing and decreasing pressure, respectively; the dashed curve shows the analogous dependence of the magnetic susceptibility χ [2].

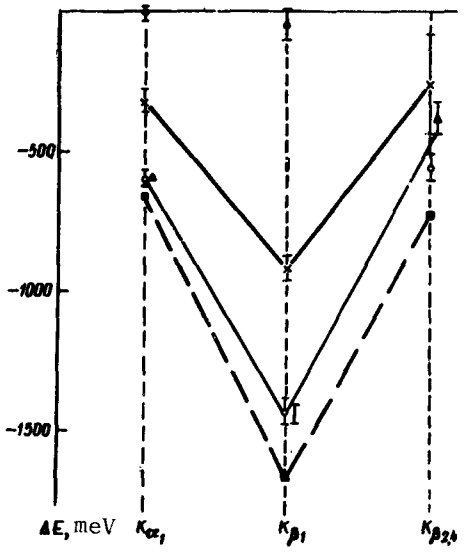

Fig. 2. Plot of line shift vs. type of line. SmF_3 - $SmCl_2$: squares — calculated for $Sm^{3+}4f^5$ - $Sm^{2+}4f^6$, triangles — experiment; SmF_3 - SmS: light circles — experiment; SmS_I - SmS_{II}: crosses — experiment, $P_I > 9$ kbar, P_{II} 1 atm; dark circles — control experiment, $P_I = P_{II} = 1$ atm.

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x-ray K lines of samarium (z = 62) in SmS.

Our experimental setup is analogous to that used in [6]. It constitutes a special x-ray Cauchois spectrometer, in the field of view of which the compared samples are placed in sequence. The only difference is that in our case the samples, which are mixtures of powdered SmS with polyethylene (the preparation method is described in [7]), are placed in the cavities of two identical chambers with beryllium windows, to which pressures up to $\sim$ 10 kbar can be applied.

Figure 1 shows the experimental results. One of the chambers was at atmospheric pressure, and the pressure in the second was varied in steps and the shift of the $K\beta_1$ line was measured at each value of the pressure. A reversible effect was observed (the energy of the $K\beta_1$ line of the compressed sample decreased) and reached approximately one electron volt at saturation; the effect vanished, with hysteresis, when the pressure was removed. The dashed line shows the pressure dependence of the magnetic susceptibility χ, as observed in [2] (the scales are so chosen that the effects coincide at saturation). The similarity of curves is a sufficient reason for concluding that the effects have a common cause.

To determine the mechanism of the phenomenon, we plotted the measured line shift against the type of line [4] ($K\alpha_1$, $K\beta_1$, $K\beta_{2,4}$). The triangles in Fig. 2 show the results for the "standard" pair SmF_3-$SmCl_2$, regarded as an ionic compound of tri- and divalent samarium with configurations $4f^5$ (Sm^{3+}) and $4f^6$ (Sm^{2+}), which differ by one 4f electron. The plot has the expected V-shape [4 - 6] close to that predicted by the Hartree-Fock-Slater calculation (dashed curve in Fig. 2; the details of the employed calculation program are given in [8]). The plot of SmF_3-SmS (light circles) is identical. This shows that in the uncompressed SmS the samarium is divalent, just as in $SmCl_2$. The crosses and the thick line show the results of a comparison of SmS samples, one at atmospheric pressure and the other at a pressure exceeding 9 kbar. A V-shape dependence is observed, indicating that the valence of the samarium is increased under pressure as a result of the lower number of 4f electrons.

The table lists the numerical results of the experiments. The last line shows the experimental values of η. They were obtained by dividing the displacement in the phase transition (second line) by the energy difference of the K lines of SmF_3-SmS (or SmF_3-$SmCl_2$). We subtracted in the denominators the correction (second line from the bottom of the table) obtained by the Hartree-Fock-Slater calculation and accounting for the fact that the "crowded-out" 4f electron is not removed to a ligand, but goes over to the 5d shell of the samarium. The correction is small and hardly affects the weighted mean value $\eta = 0.62 \pm 0.03$ electron/atom, which is in good agreement with the previously obtained $\eta = 0.77 \pm 0.06$ [2] from the changes of the SmS lattice parameters.

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A	B	$\Delta E = E_A - E_B$, meV			Note
		K_{α_1}	K_{β_1}	$K_{\beta_{2,4}}$	
SmS $P \leqslant 5$ kbar	SmS $P \approx 0$	−6 ±25	−12 ±46	–	—
SmS $p > 9$ kbar	SmS $P \approx 0$	−319 ±43	−926 ±41	−258 ±180	—
SmF_3	$SmCl_2$	−578 ±22 −606 ±19	−1438 ±56 −1455 ±50	−293 ±85 −415 ±50	Our data Data of [4]
SmF_3	SmS	−595 ±20	−1430 ±40	−556 ±50	—
Sm^{3+}, $4f^5$	Sm^{2+}, $4f^5 5d'$	−62	65	60	HFS calculation
η		0.60 ±0.08	0.62 ± 0.03	0.42 ±0.30	—

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EFFECTIVE 1.054 → 1.54 μ STIMULATED EMISSION CONVERSION

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We report here, apparently for the first time, effective conversion of neodymium-laser emission (λ = 1.054 μ) into stimulated emission in the 1.54 μ band. The conversion was obtained by using the neodymium laser to stimulate emission in ytterbium-erbium glass on the $^4I_{13/2}$ - $^4I_{15/2}$ transition of the Er^{3+} ions (three-level lasing scheme). The pump radiation is absorbed in this case by the Yb^{3+} ions as a result of an electronic transition between the upper Stark component of the ground level $^4F_{3/2}$ and the metastable level $^4F_{7/2}$, with subsequent nonradiative transfer of the excitation energy to the Er^{3+} ions (Fig. 1). Although the initial sublevel of the absorptive transition is very weakly populated at room temperature ($\sim 1.5\times10^{-2} n_0$), introduction of very large Yb^{3+} concentrations into the glass (up to 1.5×10^{21} cm^{-3}) guarantees an absorption coefficient on the order of several hundredths of a cm^{-1} at the pump frequency. Such an absorption level, of course, gives rise to high threshold densities of the exciting radiation, but these are obtainable in the neodymium-laser pulses and do not exceed the optical strength of the glass. At the same time, when the absorption is weak it becomes possible to obtain exceptionally uniform excitation of large volumes of the active medium. Our preliminary analysis and spectral-luminescence investigations of the characteristics of Yb^{3+} + Er^{3+} ion systems in various