I. A. Smirnov. *Rare-Earth Semiconductors*. The paper briefly reviews the physical properties of a new class of materials, the rare-earth semiconductors (RES). RES are compounds that contain a rare-earth ion with an unfilled inner *f* shell. The paper discusses the specifics of RES and how they differ from the standard semiconductor materials (Ge and Si, $A^{III}B^{V}$ and $A^{II}B^{VI}$ compounds, and others). Most RES are magnetic semiconductors.

Most of the author's attention is given to three groups of RES: 1) europium monochalcogenides (EuX); 2) samarium monochalcogenides (SmX); 3) compounds of the type $Ln_2X_3-Ln_3X_4$ (X = S, Se, Te; Ln is the rare-earth metal).

The magnetic *europium chalcogenide* semiconductors possess unique properties: giant negative magnetoresistance (the magnetoresistances vary through several orders), the appearance of an unusual low-temperature (near 50 °K) dielectric-metal transition in certain compositions, a large "red shift" of the absorption edge near the magnetic-ordering temperatures, and strong sensitivity of this shift to external magnetic fields. The very fact that the dielectric EuO has a high absolute Curie temperature (~69 °K) can in itself be considered sensational. The gigantic effects in the compounds EuX also include a sharp change in the physical properties of these materials on very light doping with Ln^{3+} impurities and an uncommonly large value of the Faraday effect.

Among the compounds SmX, the paper gives detailed consideration to the properties of samarium monosulfide. An isostructural (NaCl–NaCl) first-order semiconductor-metal phase transition is observed in SmS under a hydrostatic pressure of ~6.5 kbar at 300 °K. The metallic phase of SmS has a number of unusual properties that are found only in a limited class of compounds. The paper considers methods of obtaining the metallic modification of samarium monosulfide (under hydrostatic pressures above 6.5 kbar with formation of solid-solution systems of the type $Sm_{1-x}Ln_x^{+3}S$—"chemical collapse," and by mechanical polishing of SmS semiconductor films). Low-temperature and high-temperature metal-semiconductor phase transitions have been observed in the solid-solution system for several compositions. The paper discusses properties of the metallic SmS phase obtained by mechanical polishing.

The $Ln_2X_3-Ln_3X_4$ *systems* exhibit interesting properties. Ln_2X_3 and Ln_3X_4 are boundary compositions of the same phase within which the same structural type is preserved with almost no change in lattice constant, while the electrical properties change from dielectric to metallic. Ln_2X_3 is a dielectric with a wide forbidden band in which every 9-th site of the cationic sublattice remains vacant, i.e., there are ~10^{21} vacancies per cm^3. The electrical conductivity may vary through 13 orders within the phase. The paper briefly discusses the technological complexities of making RES single crystals and thin films, the possibilities for practical use of these materials, and the organization and design of research on the RES problem in the USSR and abroad.

The report was prepared from the following papers and reviews:

[1]P. Wachter, CRC Rev. in Sol. State Sci. 190 (1972).

[2]A. V. Golubkov, E. V. Goncharova, V. P. Zhuze, G. M. Loginov, V. M. Sergeeva, and I. A. Smirnov, Fizicheskie svoĭstva khal'kogenidov redkozemel'nykh elementov (Physical Properties of Chalcogenides of Rare-Earth Elements), Nauka, Leningrad, 1973.

[3]T. L. Bzhalava, T. B. Zhukova, I. A. Smirnov, S. G. Shul'man, and N. A. Yakovleva, Fiz. Tverd. Tela (Leningrad) 16, 3730 (1974) [Sov. Phys. Solid State 16, 2428 (1975) .

[4]I. A. Smirnov, Paper at Fourth Urals Winter Workshop on Semiconductor Physics, Sverdlovsk, 1975.

[5]V. V. Kaminskiĭ, A. I. Shelykh, T. T. Dedegkaev, T. B. Zhukova, S. G. Shul'man, and I. A. Smirnov, Fiz. Tverd. Tela (Leningrad) 17, 1546 (1975) [Sov. Phys. Solid State 17, 1015 (1975)].

[6]S. G. Shul'man, T. L. Bzhalava, T. B. Zhukova, T. T. Dedegkaev, and I. A. Smirnov, *ibid.*, p. 2389 [1576 (1976)].

[7]A. Jayaraman, P. D. Dernier, and L. D. Longinotti, High. Temp.-High Press, 7, 1 (1975).

[8]V. S. Oskotskiĭ and I. A. Smirnov, in book: Fizika i khimiya redkozemel'nykh poluprovodnikov (obzor) (Physics and Chemistry of Rare-Earth Semiconductors (A Review)), Nauka, Leningrad, 1977.

[9]V. A. Kapustin, *ibid.* (review).

[10]S. M. Varna, Rev. Mod. Phys. 48, 219 (1976).

Translated by R. W. Bowers