shown in the last column. The high values in the other two determinations are unexplained. From this table it is evident that the heat of wetting of lead sulfate is zero, within the limit of experimental measurement.

Grateful acknowledgment is hereby made to Professor The Svedberg for his aid in the determination of the surface areas of the lead sulfate and for help in the solution of the problems involving radioactivity, as well as for many other helpful suggestions during seven months of the work.

Summary and Conclusions

An attempt was made to establish the relation between the heat of wetting of lead sulfate and its surface area. The surface areas of a number of samples of lead sulfate were determined by the use of a radioactive isotope of lead, thorium B, as indicator. The surface areas varied between 5840 and 32,400 sq. cm. per g. of the sulfate. The maximum surface of the total lead sulfate used in any one determination on the heat of wetting was 529,000 sq. cm. The value for the heat of wetting was zero within experimental error (0.09 cal.). This warrants the conclusion that the heat of wetting of lead sulfate when wetted with water saturated with lead sulfate is less than 0.09 cal. per 529,000 sq. cm., or less than 1.69×10^{-6} cal. per sq. cm. for lead sulfate that has been dried for 110 hours at a temperature of 224° and at a pressure of 0.005 bar.

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[CONTRIBUTION FROM THE RESEARCH LABORATORIES OF THE AMERICAN TELEPHONE AND TELEGRAPH COMPANY AND THE WESTERN ELECTRIC COMPANY, INCORPORATED]

PHOTOMICROGRAPHIC EVIDENCE OF THE CRYSTAL STRUCTURE OF PURE CERIUM

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A review of the literature reveals the fact that practically no reliable microscopic work has ever been done on the crystallographic properties of pure metallic cerium. There are two reasons for this: first, very little pure cerium has been isolated; and second, it is extremely difficult to prepare the specimens for microscopic examination because the metal oxidizes rapidly and thus is difficult to polish, and because it is violently attacked by practically all reagents which may be used for etching. This investigation was undertaken to secure information concerning the crystal structure of cerium, since some of this metal of a high degree of purity was available as a result of work recently carried on in this Laboratory.

Preparation of Pure Cerium

The cerium used in this study was prepared by electrolyzing some exceedingly pure cerium chloride. Both the anode and the electrolytic cell, which acted also as the cathode, were made of Acheson graphite. The deposited metal was first washed with water so as to remove all adhering salt and carbide and was then remelted in a magnesia crucible under a flux of pure sodium chloride. This remelted preparation was found by analyses to contain 99.9% of cerium, 0.03% of carbon and 0.02% of iron.

Preparation of Specimens for Microscopic Examination

Several pieces of cerium were carefully polished in the usual manner. They were then allowed to oxidize slowly in a desiccator. After the prepared surface had been oxidized for about seven days it was cleaned by etching with concd. nitric acid. This acid ordinarily causes the formation of a dense brown surface film which obliterates the surface characteristics of the metal, but by etching quickly the action is arrested before the film has sufficient time to form over the whole surface, and thus fields free from the deposit are obtained.

Photomicrographs

Several samples of cerium were examined and photographed but since the same structure was always in evidence only two of the photomicrographs are reproduced here.

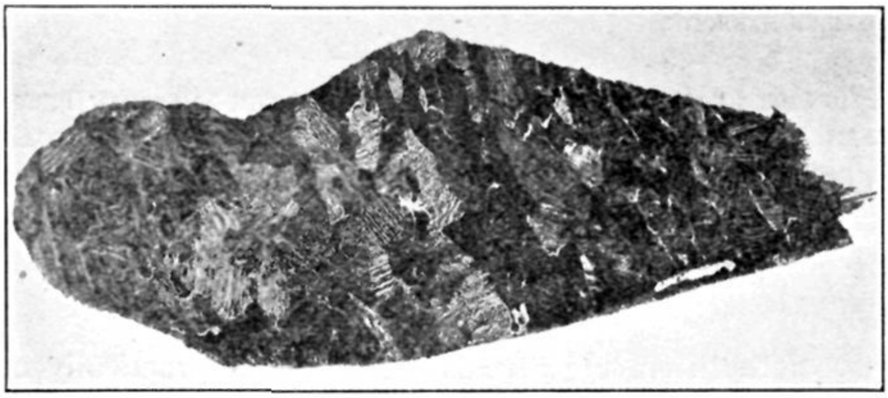

Fig. 1.

Fig. 1 shows that this specimen of cerium is comprised of large elongated grains each of which is traversed by groups of lines. The lines of any single grain bear definite angular relationship to one another but adjoining grains differ in their orientation.

Fig. 2 shows a small area of a representative grain at high magnification, 1080X, from which the orientation of the crystallographic structure for this particular grain is evident. This field and many others were studied, but in no case could more than three sets of lines be found. If the metal crystallizes in the form of octahedra, two, three, or four sets of lines might be found depending on whether the section was cut parallel to the surface of a cube (two sets of lines), parallel to the surface of an octahedron (3 sets of lines), or at some intermediate plane (four sets of lines). If the metal crystallizes in the form of a cube two or three sets of lines should be found depending on whether the cutting plane is parallel to the surface of a cube or at some angle to such a surface.[1] Thus in the case of octahedral crystallization the optimum number of sets of lines would be four and in the case of the cubic crystallization three. Since we were unable to find any field in which more than three sets of lines were present we conclude that cerium crystallizes in the regular system, cubic form. This conclusion is borne out by the fact that under certain conditions of etching the edges of individual crystals showed unmistakable evidence of cubic orientation. Hull[2] concludes from the X-ray method of crystal analysis that "cerium appears to be composed of a mixture of the hexagonal and cubic forms of close-packed arrangement of atoms, like cobalt."[3] The crystal structure of pure cobalt has been investigated by high power photomicrography and in this case substantial evidence was found to indicate both cubic and hexagonal crystallization, but in the specimens of cerium examined by us evidence of the hexagonal system is entirely lacking.

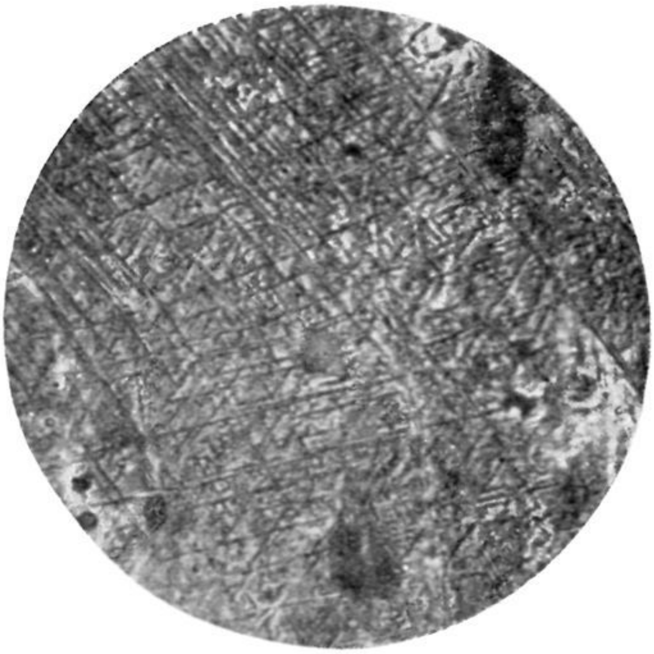

Fig. 2.

Summary

Cerium of a high degree of purity has been produced and a microscopic study made of its crystal structure which indicates that the metal crystallizes in the regular system, cubic form.

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[1] Belaiew, "Crystallization of Metals," *Metal Ind.*, **22,** 564 (1923).

[2] Hull, *Phys. Rev.*, **18,** 89 (1921).

[3] Lucas, *Trans. Am. Soc. Steel Treating*, **4,** 610 (1923).