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Structural and thermodynamic characteristics of mechanically treated sulfur

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Abstract

Elemental sulfur is one of the most widely used chemical products in modern chemical technology, the production of sulfuric acid and fertilizers, but despite the huge volume of its use, there is a disproportion between demand and consumption in the sulfur market. Although as a result of years of intensive research on the properties of elemental sulfur, significant material has been accumulated, the need to develop new ways of sulfur using requires further research into its fundamental characteristics using modern scientific equipment. In connection with this, the problems of new sulfur-containing chemical products creating with the use of modern methods of mechanochemistry and nanotechnologies are currently actual. Many applications of sulfur are associated with its use in a dispersed state and problems associated with grinding sulfur in various grinding devices associated with aggregation of particles are known. The results of intensive grinding in a centrifugal mill indicate significant changes in the structural and thermodynamic states of mechanically treated sulfur. The results of the influence of mechanical treatment in a centrifugal sulfur mill on the structural and thermal characteristics of elemental sulfur and on the results of the synthesis of calcium polysulphide are presented in the article. It was found that grinding in a centrifugal mill leads to a significant reduction in size: particles of micron sulfur with sizes from 10 to 200 μm move to the range from 50 nm to 50 μm, with 20% of the particles located in the submicron range from 60 nm to 110 nm. It has been established that intensive grinding of sulfur is accompanied by mechanical activation of the material and this manifests itself in the form of a substantial broadening of the X-ray diffraction lines, the appearance of microdeformations, and a noticeable decrease by 16.8% in the magnitude of the thermal effect corresponding to the melting of sulfur. The use of activated sulfur also makes it possible to significantly improve the synthesis of calcium polysulphide – to increase the yield of the product and to reduce the amount of waste. The results can be used to create a technology for the preparation of concentrated polysulfide solutions that are widely used in agriculture as effective fungicides and in the construction industry for creating hydrophobisers of deep penetration.

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