Doctoral thesis

Summary

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Directional crystallization and real structure of singlecrystals of $Co_{(1-x)}Ni_xSi_2$ solid solutions

The development of the semiconductor industry and the progress of research in the field of solid state is associated with the search for technologically advanced materials. The problem of designing complex materials can be considered in two ways. The first method consists in creating from scratch materials consisting of several or even several dozen components, but in this case, we encounter difficulties resulting from the correlation between them. The second method is mainly based on designing materials with a low degree of complexity with the possibility of expanding with other components that allow to obtain more complex systems, but difficult to interpret in terms of their real structure. The mentioned paths are supported by literature analysis and are equivalent. The first method has the characteristics of a certain randomness, while the second way allows gradual exploration of a given issue and subject, which in effect gives us a more accurate and better knowledge about the scientific problem.

Disilicides are materials with a wide range of applications. We meet with them during technological processes related to the mechanical and thermal treatment of other materials, as well as that materials are the basic component of electronic circuits. Disilicides can be divided into three groups. The first group are metallic materials, e.g. $CoSi_2$, $NiSi_2$ and $TiSi_2$. The second group are materials having semiconductor properties, e.g. $CrSi_2$, $FeSi_2$, and the third group are high-temperature materials: WSi2, $MoSi_2$, $TaSi_2$. Disilicides are also used in other applications: anti-corrosion and protective coatings, passivating materials or components of composite materials. As you can see, these are versatile materials, and the only limitation of their application are economic issues.

This doctoral thesis describes the process of obtaining massive singlecrystals of $Co_{1-x}Ni_xSi_2$ solid solutions, where x = 0.10; 0.25 and 0.50 by Bridgman and Czochralski techniques. The effect of the technological work was fabrication of single crystals with established chemical compositions. A comparative identification of the microstructure t of single crystals with the same compositions obtained by the Bridgman and Czochralski technique with the aid of optical and electron techniques was carried out. In order to identify the obtained materials, X-ray quality phase analysis and X-ray microanalysis were performed. Using the Laue technique, the growth directions of the obtained single crystals were oriented. A preliminary analysis of the mechanical properties of the obtained materials was carried out by measuring the microhardness. In order to identify the real structure of the obtained singlecrystals of $Co_{1-x}Ni_xSi_2$ solid solutions, temperature studies were carried out. The specific resistance $\rho(T)$, $S(T)$ and specific C(T) heat were measured in the temperature range from 4.2K to room temperature. All obtained results were compared with available literature data.