


Unveiling the Secrets of Pressure Induced Phase Transitions in AB₂X₄ Chalcogenide Compounds: A Fascinating Journey into the World of Material Science

Springer Series in Materials Science 189

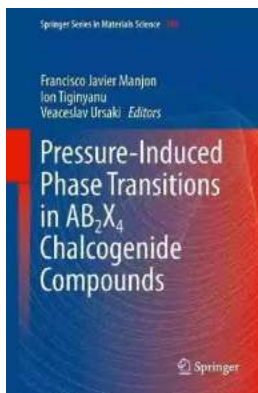
Francisco Javier Manjon
Ion Tiginyanu
Veaceslav Ursaki *Editors*

Pressure-Induced Phase Transitions in AB₂X₄ Chalcogenide Compounds

 Springer

Material science has always been a captivating field of research, offering intriguing insights into the properties and behavior of various substances under different conditions. One such intriguing phenomenon is the *pressure induced phase transition* in AB_2X_4 chalcogenide compounds, an area that has gained significant attention in recent years.

Pressure induced phase transitions occur when materials undergo structural changes due to the application of external pressure. These transitions provide a valuable opportunity to explore new material properties and uncover hidden states of matter that cannot be obtained under normal conditions.



Pressure-Induced Phase Transitions in AB_2X_4 Chalcogenide Compounds (Springer Series in Materials Science Book 189)

by Christopher Thomas (2014th Edition, Kindle Edition)

★★★★☆ 4.2 out of 5

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Understanding AB_2X_4 Chalcogenide Compounds

AB_2X_4 chalcogenide compounds belong to a family of materials that exhibit diverse properties, ranging from superconductivity to magnetism and even topological insulators. The general formula for these compounds is AB_2X_4 , where A and B represent different metallic elements, and X represents a chalcogenide element (sulfur, selenium, or tellurium).

What makes AB₂X₄ compounds particularly fascinating is their ability to undergo structural changes with varying pressure, leading to the emergence of novel phases with distinct properties. By carefully manipulating the pressure, scientists can induce these phase transitions and explore the unique behavior exhibited by these compounds under extreme conditions.

Several studies have shown that pressure-induced phase transitions in AB₂X₄ chalcogenide compounds can result in various phenomena, such as drastic changes in electrical conductivity, magnetic ordering, and even the emergence of new quantum states. These findings have opened up new possibilities for technological advancements and the development of novel materials with extraordinary properties.

Experimental Techniques

To understand pressure-induced phase transitions in AB₂X₄ chalcogenide compounds, researchers employ a combination of experimental techniques and theoretical modeling. The most commonly used experimental method is high-pressure X-ray diffraction, which allows scientists to determine the structural changes occurring in the material as pressure is applied.

Additionally, researchers utilize techniques such as Raman spectroscopy, electrical resistivity measurements, and magnetic susceptibility measurements to gain a comprehensive understanding of the material's behavior during phase transitions.

With the help of advanced computational methods, scientists can simulate and predict the effects of pressure on AB₂X₄ chalcogenide compounds. These simulations aid in interpreting experimental data and provide valuable insights into the underlying mechanisms driving the phase transitions.

Key Findings and Promising Applications

The study of pressure-induced phase transitions in AB₂X₄ chalcogenide compounds has revealed several intriguing findings:

1. Emergence of Superconductivity

Under certain pressure conditions, some AB₂X₄ compounds exhibit a transition into a superconducting state. Superconductivity is a phenomenon where electrical resistance disappears, allowing for efficient electrical current flow. The discovery of pressure-induced superconductivity in chalcogenide compounds could pave the way for the development of more efficient electrical conductors and advanced technologies.

2. Topological Insulators

Pressure-induced phase transitions in certain AB₂X₄ chalcogenide compounds can lead to the creation of new topological insulator phases. Topological insulators are materials that exhibit unique conducting properties on their surfaces while remaining insulating in the bulk. These materials hold promise for applications in next-generation electronics and quantum computing.

3. Magnetic Ordering and Spin Structures

The application of pressure can induce significant changes in the magnetic properties of AB₂X₄ chalcogenide compounds. Researchers have observed transitions between different magnetic phases, including the emergence of complex spin structures. These observations provide insights into the fundamental principles governing magnetic behavior and have implications for the development of advanced magnetic materials.

4. Pressure-Tuned Semiconductors

AB₂X₄ chalcogenide compounds can also exhibit phase transitions from semiconducting to metallic states under pressure. This tunability of electrical conductivity opens up possibilities for designing materials with tailored electronic properties for various applications, including sensors, transistors, and optoelectronics.

The Future of Pressure Induced Phase Transitions in AB₂X₄ Chalcogenide Compounds

As researchers continue to delve deeper into the world of pressure-induced phase transitions in AB₂X₄ chalcogenide compounds, several exciting avenues for exploration and application emerge.

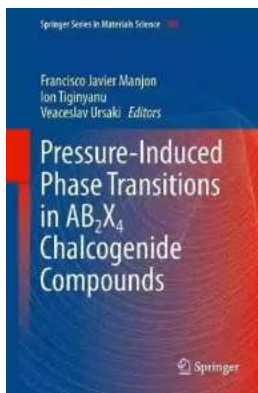
Further investigations into the underlying mechanisms driving these phase transitions can unlock new material functionalities and lead to the development of advanced technologies. By fine-tuning the external conditions, scientists may be able to control and manipulate these transitions, enabling the creation of materials with tailored properties for specific applications.

Moreover, the study of pressure-induced phase transitions in AB₂X₄ chalcogenide compounds provides valuable insights into the broader field of condensed matter physics. The discoveries made in this area contribute to our understanding of fundamental material properties and could pave the way for future breakthroughs in various scientific disciplines.

Pressure-induced phase transitions in AB₂X₄ chalcogenide compounds offer a captivating journey into the fascinating world of material science. The ability to explore and manipulate the properties of these compounds under extreme conditions has yielded remarkable discoveries, ranging from new superconducting states to topological insulators and tunable semiconductors.

By combining experimental techniques with theoretical modeling, scientists are unraveling the mysteries of pressure-induced phase transitions, shedding light on the underlying mechanisms and potential applications of these unique materials.

As research in this field continues, we can expect further revelations and technological advancements, bringing us closer to a future where materials are tailored to meet the diverse needs of society.



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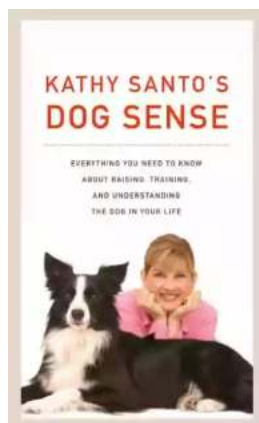
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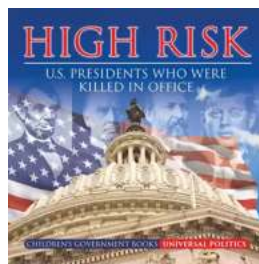
This book on pressure-induced phase transitions in AB₂X₄ chalcogenide compounds deals with one important AmBnXp material. The interest in these materials is caused by their properties. The results are discussed for three main groups of structural families: cubic-spinel structures, defective tetragonal structures, and other structures like layered and wurtzite-type modifications. A systematic analysis of the behavior of cubic (spinel), tetragonal (defect chalcopyrites and stannites) and other crystal modifications of AB₂X₄ compounds under hydrostatic pressure is performed. The behavior of AlIAl₂S₄, AlIGa₂S₄, AlIAl₂Se₄ and AlIGa₂Se₄ compounds with defective tetragonal structures,

compounds with layered and wurtzite structures under hydrostatic pressure and the pressure dependence of the band gap, lattice parameters, interatomic distances, vibrational modes and pressure-induced phase transitions is discussed. Many of these compounds, except oxide spinels, undergo a pressure-induced phase transition towards the rocksalt-type structure. The phase transition is preceded by disorder in the cation sublattice. The dependence of the transition pressure to the rocksalt-type structure as a function of the compound ionicity and the size criterion is analyzed. At high pressures, all ordered-vacancy compounds are found to exhibit a band anticrossing between several conduction bands that leads to a strong decrease of its pressure coefficient and consequently to a strong non-linear pressure dependence of the direct bandgap energy. Theoretical studies of phase transitions in several ordered-vacancy compounds reveal that the existence of ordered vacancies alter the cation-anion bond distances and their compressibilities. The book is written for students, Ph D. students and specialists in materials science, phase transitions and new materials.



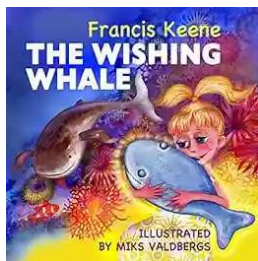
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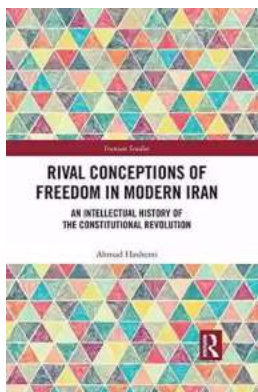
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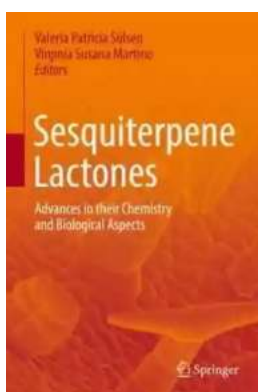
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