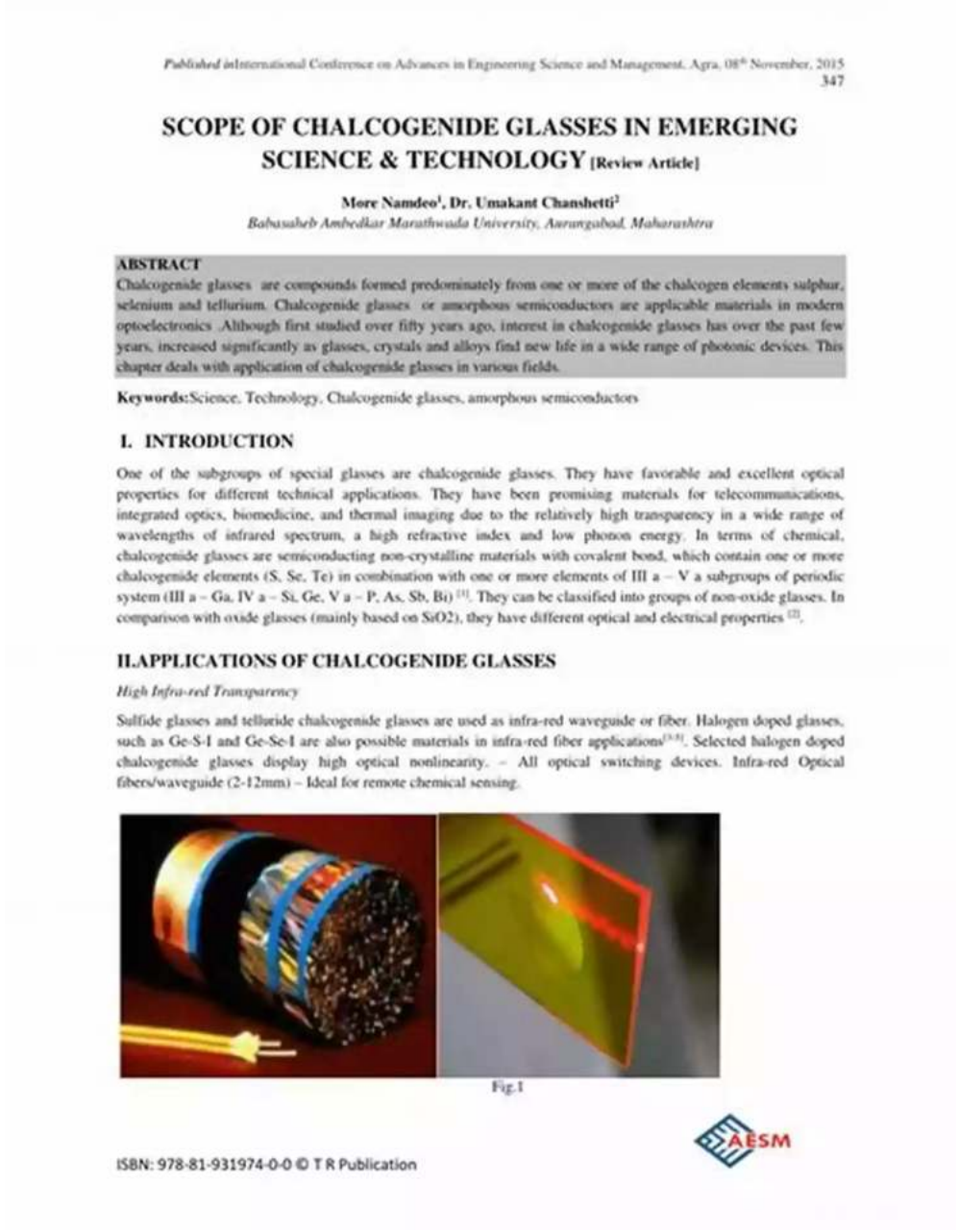
The Surprising Properties of Chalcogenide Glasses: Unveiling the Secrets of These Unique Materials



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SCOPE OF CHALCOGENIDE GLASSES IN EMERGING SCIENCE & TECHNOLOGY [Review Article]

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ABSTRACT
Chalcogenide glasses are compounds formed predominately from one or more of the chalcogen elements sulphur, selenium and tellurium. Chalcogenide glasses or amorphous semiconductors are applicable materials in modern optoelectronics .Although first studied over fifty years ago, interest in chalcogenide glasses has over the past few years, increased significantly as glasses, crystals and alloys find new life in a wide range of photonic devices. This chapter deals with application of chalcogenide glasses in various fields.

Keywords: Science, Technology, Chalcogenide glasses, amorphous semiconductors

I. INTRODUCTION

One of the subgroups of special glasses are chalcogenide glasses. They have favorable and excellent optical properties for different technical applications. They have been promising materials for telecommunications, integrated optics, biomedicine, and thermal imaging due to the relatively high transparency in a wide range of wavelengths of infrared spectrum, a high refractive index and low phonon energy. In terms of chemical, chalcogenide glasses are semiconducting non-crystalline materials with covalent bond, which contain one or more chalcogenide elements (S, Se, Te) in combination with one or more elements of III a – V a subgroups of periodic system (III a – Ga, IV a – Si, Ge, V a – P, As, Sb, Bi) [1]. They can be classified into groups of non-oxide glasses. In comparison with oxide glasses (mainly based on SiO_2), they have different optical and electrical properties [2].

II.APPLICATIONS OF CHALCOGENIDE GLASSES

High Infra-red Transparency

Sulfide glasses and telluride chalcogenide glasses are used as infra-red waveguide or fiber. Halogen doped glasses, such as Ge-S-I and Ge-Se-I are also possible materials in infra-red fiber applications[3-5]. Selected halogen doped chalcogenide glasses display high optical nonlinearity. – All optical switching devices. Infra-red Optical fibers/waveguide (2-12mm) – Ideal for remote chemical sensing.

Fig.1

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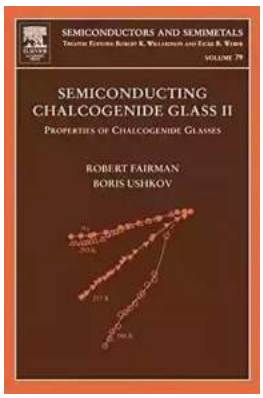
Chalcogenide glasses, also known as chalcogenide amorphous semiconductors, are an intriguing class of materials that have garnered significant interest among

scientists, engineers, and innovators alike. These glasses are composed of combinations of sulfur, selenium, and tellurium, which exhibit unique properties not found in conventional glass materials. Their remarkable characteristics make them valuable in a wide range of applications, from optical devices to memory storage technologies.

The Composition and Structure of Chalcogenide Glasses

Chalcogenide glasses are typically formed by combining chalcogen elements such as sulfur (S),selenium (Se),and tellurium (Te) with various other elements like germanium (Ge),gallium (Ga),or antimony (Sb). This flexible composition allows scientists to tailor the properties of chalcogenide glasses to meet specific application requirements.



Semiconducting Chalcogenide Glass II: Properties of Chalcogenide Glasses (ISSN Book 79)

by Lars Anderson(1st Edition, Kindle Edition)

★★★★★ 5 out of 5

Language	: English
Hardcover	: 138 pages
Item Weight	: 15.2 ounces
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File size	: 11608 KB
Text-to-Speech	: Enabled
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Print length	: 182 pages
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The underlying structure of chalcogenide glasses is amorphous, meaning they lack any long-range order found in crystalline materials. Instead, the atoms form a

random network, resulting in unique properties not observed in crystalline materials. This amorphous structure contributes to their remarkable optical, electrical, and mechanical properties.

The Optical Properties of Chalcogenide Glasses

Chalcogenide glasses exhibit a fascinating range of optical properties, making them ideal for optical devices and systems. One of their noteworthy characteristics is their high refractive index, which allows for efficient light transmission and manipulation. This property is particularly valuable in optical fibers, lenses, and infrared sensors.

Another remarkable optical property of chalcogenide glasses is their transparency in the infrared region. These glasses can transmit light across a wide range of infrared wavelengths, making them suitable for the development of infrared detectors, thermal imaging devices, and spectroscopic applications.

The Electrical Properties of Chalcogenide Glasses

Despite being amorphous, chalcogenide glasses exhibit semiconducting behavior, which makes them unique compared to other glass materials. This property opens up opportunities for their use in electronic and optoelectronic devices. By carefully tuning their composition and doping levels, chalcogenide glasses can be engineered to exhibit specific electrical properties, such as high conductivity or tunable resistivity.

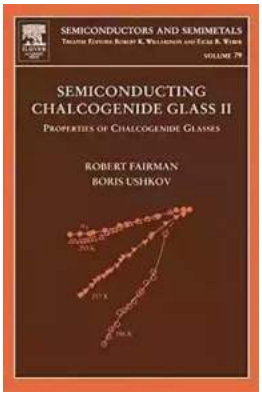
The malleability of their electrical properties, coupled with their excellent transparency in the infrared range, has made chalcogenide glasses a promising material for phase change memory (PCM) devices. PCM technology utilizes the ability of chalcogenide glasses to change their electrical resistance when exposed to heat, enabling high-density data storage and fast access times.

The Mechanical Properties of Chalcogenide Glasses

Chalcogenide glasses possess intriguing mechanical properties, characterized by their low melting points and high thermal expansion coefficients. These properties make them amenable to various fabrication techniques, including photolithography and direct laser writing. Such techniques enable the fabrication of complex microstructures on the surface of chalcogenide glasses, opening up possibilities for integrated optics, photonic circuits, and microfluidic devices.

The properties of chalcogenide glasses continue to amaze researchers and scientists, as they push the boundaries of what is possible in the realm of materials science. Their unique combination of optical, electrical, and mechanical properties make them a versatile material with applications ranging from optics and electronics to data storage and beyond.

Exploring the potential of chalcogenide glasses is an ongoing endeavor, with numerous avenues for future research. As scientists delve deeper into the secrets of these remarkable materials, we can expect to see further advancements and breakthroughs that will shape the future of technology.



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Chalcogenide glass is made up of many elements from the Chalcogenide group. The glass is transparent to infrared light and is useful as a semiconductor in many electronic devices. For example, chalcogenide glass fibers are a component of devices used to perform laser surgery.

The properties of chalcogenide glass result not only from their chemical composition and atomic structure, but also from the impact of numerous external factors. A comprehensive survey is presented of the properties of chalcogenide glass under various external impacts. Practical recommendations are presented for a wide range of applications.

Part II is the second part of a three-volume work within the Semiconductors and Semimetals series.

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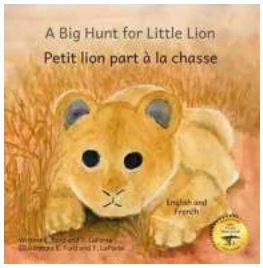

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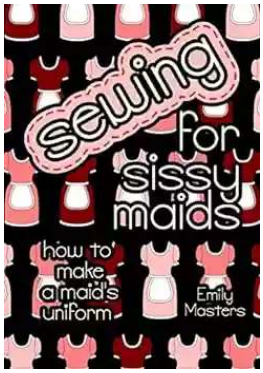

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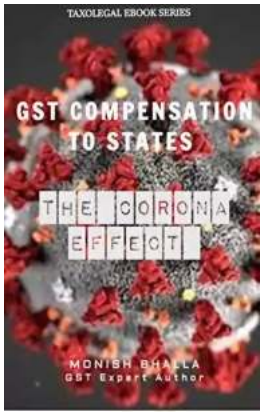

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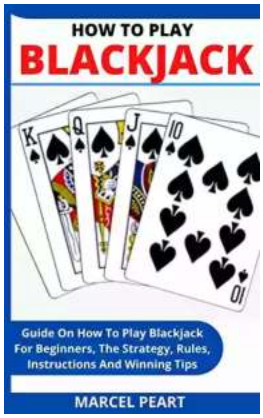

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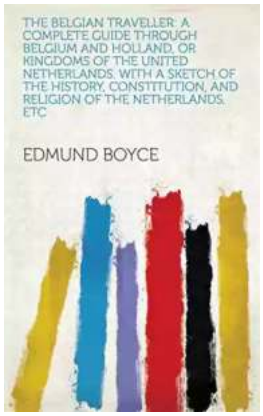

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