

A SHORT OVER VIEW ON ADVANTAGE OF CHALCOGENIDE GLASSY ALLOYS

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Modern society needs comfort in living. This can be full science and technology with innovations. In recent years almost in every sector (material science) of scientific field have gain remarkable improvements. Despite of several existing semiconducting materials (such as Si, Ge and oxide semiconductors) the amorphous semiconductors or non oxide glasses have also proved the utility at technological level due to kind of optical, electrical & dielectrical thermal [1-4] variable physical properties. Chalcogenide glassy alloys can be made easily either conventional or other suitable techniques by adding the one or more appropriate periodic table elements. Chalcogenide glassy materials are applicable in various technologies owing to adequate amorphous semiconducting features. In this work one has outlined the few most promising features of these materials.

Surface plasmon resonance (SPR) is a very versatile and accurate technique for determining small changes in optoelectronics parameters such as refractive index at the interface of a metal layer and the adjacent dielectric medium. The SPR detection mechanism has secured a very important place among several sensing techniques due to its better performance and reliable procedure. Chalcogenide glass (or non oxide glass) based optical materials can be potential candidates for designing SPR sensors to operate in the near-IR region.

Fiber-based infrared sensing has been established as an efficient, non-destructive and highly selective technique for the detection of organic and biological species. This technique combines the benefits of ATR spectroscopy with the flexibility of using a fiber as the transmission line of the optical signal, which allows for remote analysis during field measurements or in clinical environments. The sensing mechanism is based on the absorption of the evanescent electric field, which propagates outside the surface of the fiber and interacts with any absorbing species at the fiber interface. This mechanism is analogous to that observed with an ATR crystal; however the fiber geometry creates a large number of internal reflections, which enhances detection sensitivity.

The availability of fibers with high infrared transmission in the spectral region between 400 and 4000 cm^{-1} allows to collect the highly specific vibrational spectrum of organic chemicals and biomolecules. Thus the ability to monitor metabolic processes in live cells has interesting potential to design the bio-optic sensors. Disruption of the cell metabolism can be observed in response to minute amounts of toxicants, which would otherwise be far below the detection limit of IR spectroscopy. In effect, the cells act as a sensitizer for the IR sensor [5]. Additionally, the process of monitoring a cell response permits detection of a wide range of compounds, which may have similar toxicological activities but different molecular structure. Hence biochemicals are detected based on their activity rather than identity, an important distinction critical in the design of sensors.

Chalcogenides glassy materials have wide optical windows in the mid-infrared region permit to scan the entire spectral range containing the vibrational modes of biomolecules. The optimal rheological properties of these glasses allow fiber drawing without devitrification and optical loss. They can be shaped and processed to reduce the diameter of the sensing zone for higher detection sensitivity and better mechanical flexibility. In addition, amorphous chalcogenides effectively resist chemical corrosion, which is good for biocompatibility with live biological components. The glassy chalcogenides have also an apparent hydrophobic surface

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characteristic, which appears to attract non-polar organic species, while repelling water. As a consequence, the optical signal of organic species enhanced relative to water [6].

The efficiency of controlled the multilayer optical filters by periodically switching and evaporation angle, leading to periodic dielectric structures. The porosity levels of the films controlled by the tilting, when substrate away from deposition source, leads to controlled variations in the effective optical constants, which make chalcogenide glasses are promising materials for chemical sensing [7].

Chalcogenide glass based devices have also shown the possibility of fabrication of ultra-low loss waveguides due to their larger refractive index amongst glasses. IV group chalcogen elements (sulfur, selenium and tellurium) have generated significant interest over the past decade owing to their transparent behavior in the near-to mid-infrared region. Chalcogenide glassy alloys can also form by adding metallic materials (like Ag, Cu, Fe, Cd, Zn etc) [8-13], to obtain the higher order of thermal stability.

The binary chalcogenide glasses have been the subject of much research and technological development over the past several decades [14-15]. Ternary and quaternary glasses [16-20] are often realized by combining the binary compositions or by addition of other elements. Comparing the sulfide and selenide glasses, the sulfide glasses are typically characterized by a wider bandgap, higher glass transition temperature, lower density, greater hardness and higher thermal conductivity. Some of the interesting technological properties of chalcogenide glasses [21] for integrated optics are given as;

- Chalcogenide glasses have high refractive indices. This fact combined with their processing options has made them of interest for photonic crystal research.
- Their relatively high atomic masses and weak bond strengths result in chalcogenide glasses having low characteristic phonon energies (350–450 cm⁻¹), even relative to fluoride glasses (550 cm⁻¹). On the other hand, chalcogenide glasses have narrow bandgaps (2 eV) and relatively poor transparency (compared to oxide glasses) in the visible and UV wavelength regions.
- Related to their weak bonding arrangements, chalcogenide glasses exhibit an array of photoinduced structural changes. In some cases, these photoinduced effects are apparently unique to the chalcogenide glasses, while in other cases it is the magnitude of the effects that is notable. Near bandgap, light can be used to induce relatively large changes in glass absorption (photodarkening or photobleaching) and refractive index, useful in the patterning of gratings and waveguides. Further, such exposure typically modifies the physical structure of the glass and alters its etch characteristics, making chalcogenide glasses interesting as inorganic photoresists.
- Particularly unique photodoping, a metal film is deposited on a chalcogenide glass and light near the bandgap wavelength of the chalcogenide glass causes dissolution of the metal by the chalcogenide glass.
- Another unique physical characteristic is the reversible amorphous to crystalline phase change that can be induced by controlled thermal cycling (through laser absorption or current flow) of certain chalcogenide alloys. The commercially successful rewritable CD/DVD.
- Related to their narrow bandgaps and high linear refractive index, chalcogenide glasses exhibit high nonlinearities in the near IR wavelength region. With Kerr nonlinear coefficients two to three orders of magnitude higher than those of silicate glasses, chalcogenide glasses hold promise for realization of all-optical devices in fiber networks.
- Recently, phase-change materials for novel nonvolatile memory technologies have intensified. All of the current phase-change memory designs are based on current-induced (orthreshold) switching, where the phase-change material is directly Joule heated. Because these concepts rely on a nonlinear conduction mechanism, where conductive filaments are formed within the storage material once the applied field exceeds a threshold, such memory cells show a very nonlinear and pronounced resistance change during the write process.

Phase-change materials, such as the chalcogenide glasses are technologically very important for read–write storage device, because they can be switched (in nanoseconds) rapidly back and forth between amorphous and crystalline phases by applying appropriate heat pulses. In optical storage, the heat pulses are realized by a sharply focused laser diode, and during read-out the state of the recorded bits is sensed optically, using the same laser at a lower power level.

Although optical phase-change storage is a widespread and successful technology, further advances in areal densities will be very challenging [22,23].

Outcomes of recent studies also reveal that the developments in microbolometer fabrication technology reduced the pixel size and cost of uncooled focal plane arrays. Arrays with smaller pixels are driving thermal imaging applications towards more compact, faster lenses, with better image quality. Also, the lower cost of uncooled detector arrays is driving down the cost of the infrared (IR) optics, making thermal imaging more accessible to high-volume commercial applications. Usually, the image quality of a lens can be improved by a more complex design, with more elements. However, in most commercial applications, where cost, size, and weight are important factors, compact lenses with minimal number of elements are preferred. Another important aspect in IR imaging applications is maximizing the amount of light falling onto the detector. Designs with a smaller number of elements will reduce transmission loss due to surface reflections and bulk absorption [24].

To obtain low-cost optics for thermal imaging, two essential conditions should be satisfied the materials: inexpensive starting materials and economical process for producing lenses. With regard to these conditions, chalcogenide glasses have unquestionable advantages over germanium. Commercially available chalcogenide glasses are mainly composed of cheap and abundant selenium with germanium content ranging from 20% to 33% (atomic percentages). It is generally much easier and faster to produce glass blanks than to grow single crystals [25].

Chalcogenide glasses can also used as photovoltaic solar cell materials, particularly in thin film form. Chalcogenides are high performance and cheaper photovoltaic solar cell materials than silica or other photovoltaic solar cell materials. These materials can also used in xerographic process due its higher crystallization rate ability [26].

In conclusive remarks, chalcogenide materials are future prospective materials which would be provide less expensive technical devises in field of optoelectronics, owing to their versatile thermophysical, optical, mid-infrared and electrical properties. Hence materials can be useful for all type of optical devices as well as other applications. Thus the area of chalcogenide glasses or non-oxide glasses is still growing and open for investigations.

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