4-17-2019

Materials Characterization of Dissolved Chalcogenide Spin Coated Thin Films

Shah Mohammad Rahmot Ullah
Boise State University

Al-Amin Ahmed Simon
Boise State University

Maria Mitkova
Boise State University

Materials Characterization of Dissolved Chalcogenide Spin Coated Thin Films

S. M. R. Ullah, A. Ahmed Simon, M. Mitkova
Department of Electrical and Computer Engineering, Boise State University

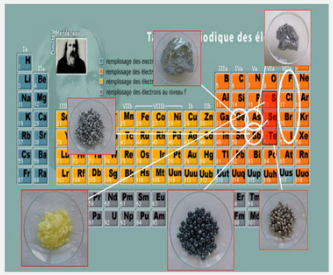
BOISE STATE UNIVERSITY

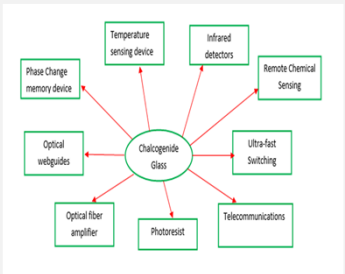
Introduction

Additive manufacturing technology or 3D printing is a process that creates a physical object from a digital design. Our main goal is to fabricate a space grade radiation sensing device using additive manufacturing technology. Ink development is the first phase of this process. We have developed both nano-particle and dissolved ink [1]. In this presentation we demonstrate the dissolved ink making process of Se based chalcogenide glass and report material characterization of dissolved Chalcogenide Spin Coated Thin Films using tensiometer, XRD, SEM, EDS.

Chalcogenide Glass & Its Applications

Chalcogenide glasses have a wide range of applications because of its significant unique physical and chemical properties including absorption coefficient, nonlinear optical susceptibility, resistance, crystal structure and morphology, wide IR transmission window or high values of refractive index [2].



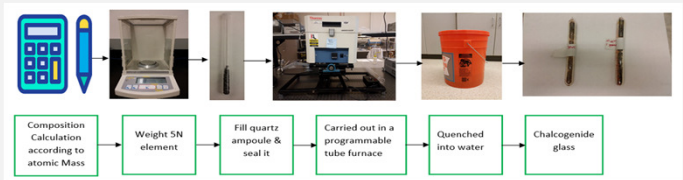


Objective

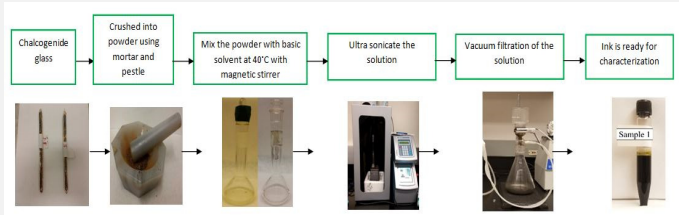
- To develop dissolution based Ge-Se chalcogenide glasses ink for fabricating radiation sensor using additive manufacturing technology.
- To apply Ag diffusion technique under radiation source to monitor radiation dose.
- Using Additive manufacturing technology to avoid complexity of conventional deposition techniques and high cost.

Experimental Method

- **Glass synthesis**



- **Dissolution based chalcogenide glass (Ge_xSe_{100-x}) ink formulation**



- **Contact angle of dissolution based chalcogenide glass ink**

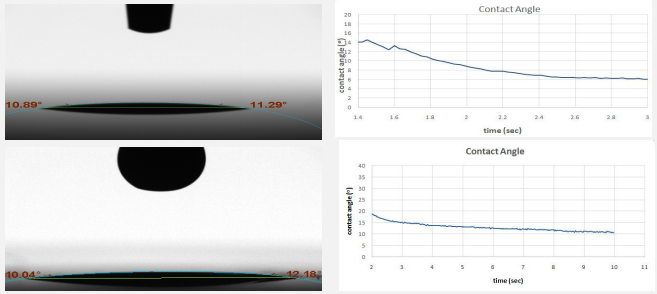
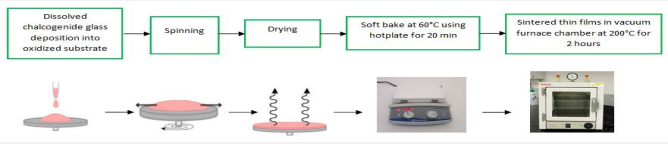


Fig. 1 Contact angle of Dissolution based chalcogenide glass ink (top) $Ge_{40}Se_{60}$, (bottom) $Ge_{30}Se_{70}$ in oxidized films.

- **Thin film preparation & sintering process**



Characterization

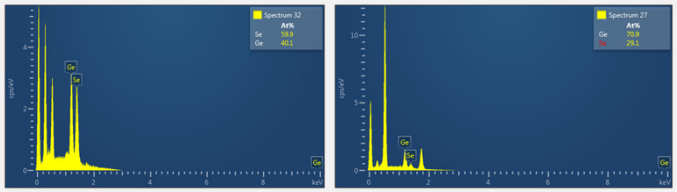


Fig. 2 (Left) EDS spectra of $Ge_{40}Se_{60}$ (right) EDS spectra of $Ge_{30}Se_{70}$ spin coated thin film shows that the compositional variance is within ±1% of the bulk . (Right)

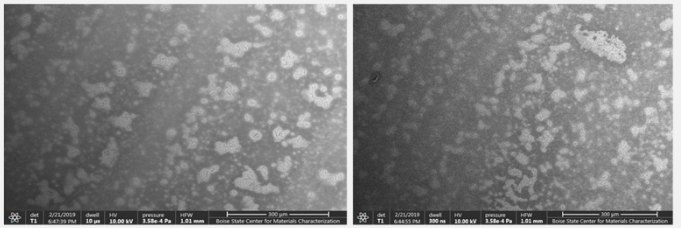


Fig. 3 SEM micrograph of spin coated $Ge_{40}Se_{60}$ (left) and $Ge_{30}Se_{70}$ (right).

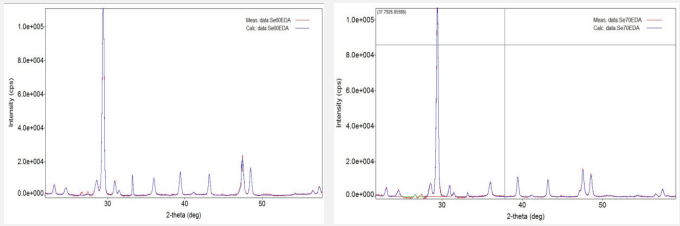


Fig. 4 (Left) XRD of spin coated thin Ge-Se film (left $Ge_{40}Se_{60}$) and (right $Ge_{30}Se_{70}$), DB no: 00-032-0410,01-083-1832, shows that the films are amorphous in nature.

Conclusion

Chalcogenide glasses are soluble in basic solutions and this property has been used for ink formation through dissolution. Before starting printing we did material and ink characterization. We measured 10º to 14º of contact angle which indicated that it has good adhesion with substrate. We also checked atomic composition of spin coated films using EDS and confirmed amorphous nature of spin coated films using XRD. In future, we will use this dissolution based ink for fabricating space grade radiation sensor using additive manufacturing technology on flexible substrate.

Acknowledgement
This research has been funded by the NASA EPSCoR (Established Program to Stimulate Competitive Research). Grant No. 80NSSC17M0029.

Reference
1. **A Ahmed Simon et al., M & M (2019) in press.**
2. **S. M. R. Ullah et al., M & M (2019) in press.**
*Courtesy of Advanced Nano-materials and Manufacturing Laboratory, Boise State University**