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M Vlcek

University of Pardubice, Czech Republic

Structuring of chalcogenide glasses spin coated thin layers

Chalcogenide glasses (CHGs) possess unique properties, which make them very attractive materials for many applications, for many of them, their thin layers (TLs) are needed which are mainly fabricated by vacuum evaporation, sputtering or ablation methods. However, these methods need high vacuum equipment, which makes their fabrication expensive. Application of solution based deposition techniques would be cheaper and simpler. The purpose of this study is to find conditions to prepare by spin coating method thin layers of As and Ge based CHGs in optical quality which possess sensitivity to either UV light or electron beam which allows their micro and nano structuring either directly by exposure or consequently by wet/dry etching. It is shown that chemical processes occurring during the chalcogenide glass dissolution and TLs deposition by spin coating determine their structure and consequently their optical and chemical properties. Increasing of annealing temperature, we observed significant thermo-induced thickness decrease together with increase in refractive index and change in their chemical stability. Raman spectroscopy measurements confirmed that these changes are results of structural polymerization of TLs glass matrix and release of organic residuals. Optical quality of prepared thin layers was confirmed by UV-VIS-NIR, SEM and AFM methods. UV light and/or electron beam exposure resulted in structural changes and consequent change of their chemical stability. Both positive and negative type of selective etching was achieved even in TLs of the same composition depending on conditions of their treatment. Suitable conditions for fabrication of optical quality thin layers of As and Ge based CHGs by spin coating method were found. These layers are sensitive to UV and/or electron beam exposure. Application of this phenomenon for fabrication of diffractive optical elements is demonstrated.

Recent Publications

1. K Palka, S Slang, J Buzek, M Vlcek (2016) Selective etching of spin-coated and thermally evaporated $As_{30}S_{45}Se_{25}$ thin films. *Journal of Non-Crystalline Solids;* 447: 104-109.

2. S Slang, P Janicek, K Palka, M Vlcek (2016) Structure and properties of spin-coated $Ge_{25}S_{75}$ chalcogenide thin films. *Optical Materials Express*; 6(6): 1973-1985.

Biography

M Vlcek has completed his PhD from Institute of Chemical Technology, Pardubice, Czechoslovakia. Presently, he is the Professor and Director of Center of Materials and Nanotechnologies at University of Pardubice, Czech Republic. He was also a Visiting Professor at Lehigh University, USA. He has published more than 130 papers and his research focuses mainly on photoinduced structural changes in chalcogenide glasses and application of this phenomenon in fields as photonics, diffractive optics and high resolution lithography.

Miroslav.Vlcek@upce.cz

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