The different crystal phases and their proportion ratio were determined by X-ray diffraction and SEM images on the glass-ceramic after treatment. The radial gradient of refractive index of the obtained glass-ceramics has been measured by Phasics at 10.6 µm.

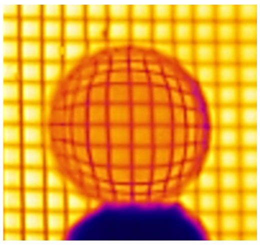

Figure. GRIN chalcogenide glass-ceramics observed with a thermal camera (8-12µm)

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Micro and nanostructuring of chalcogenide glasses

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Chalcogenide glasses, non-oxide glasses based on one or more chalcogen element (S, Se, Te), usually alloyed with more electropositive network-forming elements such as As, Ge or others posses many unique properties which make them extraordinary materials for photonics as well as applications in other fields. The presence of chalcogens and other heavy elements in the ChG structure results in broad transparency in the infrared (IR) spectral region (sulfur based glasses are transparent usually up to wavelengths 10-12 µm, selenides up to 14-16 µm and tellurides even up to 20 µm]), significant increase in refractive index (with usual values 2.0 – 3.2) in comparison with oxide glasses [1 - 2]. Chalcogenide glasses also possess much lower structural rigidity which often results in their disposition to structural changes being exposed to appropriate irradiation such as (over)band-gap light, electron beam, etc or by annealing resulting in changes of physical and chemical properties of these materials. Low rigidity also allows their direct 3 D structuring by focused laser beam exposure or by hot embossing.

In presented work we summarize our results with regard to micro- and nano- structuring of thin chalcogenide glasses thin layers fabricated by vacuum thermal evaporation techniques and by solution based deposition technique (spin coating). Thin layers structuring was realized using either exposure with photon and/or electron beam with subsequent selective etching or by direct patterning them with focused laser beam as well as by hot embossing. Examples of high optical quality diffractive optical elements fabricated in studied As and Ge based chalcogenide glasses thin layers are given and their diffractive properties are demonstrated.

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Chalcogenide materials for emerging memories

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Emerging resistive switching (RS) non-volatile memory (NVM) technologies, such as resistive random access memory (RRAM) or phase change memory (PCM), are promising candidates for the next generation of advanced data storage applications. They have a number of advantages, such as scalability, non-volatility, high switching speed, energy efficiency and ease of fabrication, that could overcome the limitations of current memory technologies.

Advanced data storage applications require NVM devices to be packed densely in vast cross-bar memory arrays to enable the storage of many terabytes of data. Accurate read and write operations in cross-bar arrays need high non-linearity in the current-voltage characteristics, to access a subset of the array. The currents passing through the selected cells have to be far greater than the residual leakage currents through the non-selected cells. A major bottleneck, in the achievement of high density RRAM/PCM arrays, is the lack of a high performing selector device in series with each memory element that allows for accurate information storage and retrieval. The selector device role is in suppressing parasitic currents through highly nonlinear current-voltage (IV) characteristics, while enabling a sufficiently high drive current for the operation of the memory element.