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.

To increase the storage density in NVM devices, multiple states can be recorded in a single PCM memory cell. There are several approaches to achieve this goal. One is to store multiple states in a single film of phase change material by controlling the crystalline to amorphous ratio in the thin film. Another approach is to stack different films of chalcogenide materials. In this case, each state corresponds to a different value of the cell resistance and to a different combination of the layer structure.

We show here our recent results in developing selector devices [1] and PCM cells [2-5].

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The photoinduced displacement of amorphous chalcogenide and photochromic organic compounds.

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The direct surface patterning of chalcogenide and photochromic organic compound amorphous films via photoinduced displacement of matter was studied. The influence of the amorphous film thickness, grating period, intensity and polarization direction state of recording beams for the holographic recording efficiency of surface relief gratings (SRG) with laser wavelengths in the spectral range of (375 nm – 671 nm) was studied. The amorphous chalcogenide films (As-S, As-S-Se, As-Se and Ge-Se systems) were studied and obtained results were compared with the measurements on photochromatic organic compound (azo-benzene containing low molecular organic glasses, epoxy and gelatin systems) thin films [1, 2].

The phase relationship between the recording light field and the resulting surface deformation was studied. It was observed that the peak of the SRG on chalcogenide films