

Current Filamentation and Switching Effect in Chalcogenide Glassy Semiconductors: A Review

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Abstract. A review on current filamentation and switching effect in chalcogenide glassy semiconductors (CGSs), which are promising materials for the development of phase change memory devices, is presented. First, a history of the research on CGSs and their properties is considered. Next, formation of a current filament in CGSs is discussed and the scale of heat release in the material as well as the geometric shape of the filament is analyzed. Finally, various hypotheses developed for the explanation of the switching effect in CGSs are reviewed. It is shown that the most relevant model of the switching effect in CGS is the model of multi-phonon tunneling ionization of the so-called ‘negative-U centers’. This model is based on the assumption that an avalanche-like increase in current at a certain point in time is associated with mass tunneling of electrons located on atoms, occurring due to thermal vibrations of atoms.

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