Mass spectrometry of chalcogenide glasses

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Chalcogenide glasses (CG) show unusual optical advantages such as high (non)linear refractive indices, good transparency in the IR spectral region and unique properties like photo-darkening, giant photo-expansion as well as photo-fluidity when irradiated by appropriate light.[1] Various techniques are known and used to fabricate the CG in different forms like bulk glasses, optical fibers and thin films.[2] These advanced materials have broad applications in the fields such as infrared optics, electronics, micro-electronics, telecommunication systems, environment and medicine.

LDI TOFMS is a powerful and useful technique to generate and study clusters of various solid materials and it was used to study CG.[3-6]

For example, chalcogenide glasses of $(GeSe_2)_{100-x}(Sb_2Se_3)_x$ system, where x = 5–60, were studied while the aim was to elucidate their structure through the analysis of clusters formed in gas phase due to interaction of pulsed laser beam with solid phase. In gas phase positively or negatively charged clusters were identified; their stoichiometry was determined as Se_c^- (c = 2–3), Sb^+, Se_2^+, and Sb_3^+; binary $GeSe_c^+$, $SbSe_c^{+/-}$ (c = 1–2), $Sb_bSe_c^+$ (b = 2–3, c = 1–4), $Ge_aSb_3^+$ (a = 1–4), $Sb_2Se_c^-$ (c = 3–4), $SbSe_3^-$, and $Sb_3Se_5^+$; ternary $GeSbSe_2^+$, $GeSbSe_c^-$ (c = 3–5), $GeSb_bSe^+$ (b = 4–5), and $Ge_9Sb_2Se_c^+$ (c = 5–7) ones via comparison of experimental isotopic envelopes with theoretical models.[6] Several other examples of MS analysis of other CG will be presented and discussed.

Concluding, identified clusters could be considered as structural fragments of the glasses original structure which was also proved by Raman spectroscopy.[5,6] Better understanding of CGs structure might help to improve their properties.

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