Generation of Clusters with Laser Desorption Ionization (LDI) and Matrix Assisted or LDI with Quadrupole Ion Trap Time-of-Flight Mass Spectrometric characterization of Inorganic Materials

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Mass spectrometry has extensive applications in science and especially MALDI for the analysis of bio-molecules. On the other hand, it can also be applied to inorganic materials. The aim of this work was to study the use of LDI QIT TOFMS for characterization of various nanomaterials, chalcogenide glasses, etc.   Several examples will be discussed.

Chalcogenide glasses As_2Ch_3 (Ch = S, Se, and Te) were ablated with laser and mass spectra were recorded in both positive and negative ion modes. Up to 102 As_mCh_n clusters were identified: 10 unary ($S_p^{+/-}$ and $As_m^{+/-}$) and 34 binary ($As_mS_p^{+/-}$) species for As_2S_3 glass; 2 unary ($Se_q^{+/-}$) and 26 binary ($As_mSe_q^{+/-}$) species in case of As_2Se_3 glass; 7 unary ($Te_r^{+/-}$) and 23 binary ($As_mTe_r^{+/-}$) species for As_2Te_3 material. The clusters results from the fragmentation of glass structure. A novel approach was developed to diminish the fragmentation of chalcogenide glasses and 45 new high mass clusters were observed when using polymers such as polyvinyl pyrrolidine (PVP), polyethylene glycol and/or Parafilm [1].

The same procedure as used for glasses was used to study formation of $W_xO_y^{+\bullet/-\bullet}$ clusters generated in gas phase via laser ablation of solid WO_3. The LDI produced $(WO_3)_n^{+\bullet/-\bullet}$ (n = 1-7) clusters while in MALDI when nano-diamonds (NDs), graphene oxide (GO), or fullerene (C_{60}) were used as matrices, higher mass clusters $(WO_3)_n^{-\bullet}$ (n =1-19) were detected. Carbonaceous materials (nano-diamonds, fullerene, and graphene oxide) were for the first time used as matrices for the generation of $(WO_3)_n^{+\bullet/-\bullet}$ clusters in the gas phase. In MALDI new high mass clusters $(WO_3)_n^{-\bullet}$ (n = 12-19) were detected [2].

Another work deals with synthesis of magnetic Co-Au nanocomposite. It was then examined as LDI and MALDI matrices. Synthetized Co-Au nanomaterial was characterized by MS and it might have various applications for drug delivery, magnetic therapy, hypothermia treatment, etc. [3,4].

Concluding, LDI with TOF MS detection was shown to be a useful technique for the characterization of various inorganic materials. The knowledge of the clusters stoichiometry is helpful for elucidation of the materials structures.

References

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