

Selected applications of mass spectrometry

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Mass spectrometry has extensive applications in biology, chemistry, physics, medicine, etc. Use of mass spectrometry for the analysis of organic, inorganic as well as biochemical samples is well known. Several mass spectrometers with advanced techniques are commercially available.

The aim of my Thesis work was to study the use of laser desorption ionization quadrupole ion trap time-of-flight mass spectrometry (LDI QIT TOFMS) for the generation of clusters from various precursors such as nanomaterials, nanocomposites, chalcogenide glasses, etc.

(i) An approach for the preparation of AgTe and AuAgTe nanocomposites was developed and found suitable for the generation of several novel $\text{Ag}_m\text{Te}_n^{+/-}$ and $\text{Au}_p\text{Ag}_q\text{Te}_r^{+/-}$ clusters [1, 2].

(ii) In paper [3] the unknown structure of AgAsS₂ glass was resolved. LDI shows the formation of 3 unary, 38 binary (As_nS_x , Ag_mS_x), and 98 ternary ($\text{Ag}_m\text{As}_n\text{S}_x$) clusters. However, the main finding was that the silver-rich grains are formed yielding clusters $\text{Ag}_{34}\text{AsS}_{18}^+$, $\text{Ag}_{32}\text{AsS}_{18}^-$, etc. for example.

(iii) The paper [4] includes a novel approach for the synthesis of giant gold nano-flowers and it was discovered that they are alloyed with iron. Formation of $\text{Au}_m\text{Fe}_n^{+/-}$ ($m = 1 - 35$; $n = 1 - 3$) clusters was described.

(iv) Concluding, LDI with TOF MS detection was shown to be a useful technique for the generation of clusters. The knowledge of the clusters stoichiometry is helpful to resolve the structures of the various materials. Thanks to the sensitivity of these MS techniques, the detection of low amount of alloyed iron in gold nanomaterial was possible.

References

[1] Ravi Mawale, Filippo Amato, Milan Alberti and Josef Havel. Generation of new Ag_mTe_n clusters via laser ablation synthesis using Ag-Te nano-composite as precursor. Quadrupole ion trap time-of-flight mass spectrometry. *Rapid Commun. Mass Spectrom.* 2014, 28, 2753–2758.

[2] Ravi Mawale, Filippo Amato, Milan Alberti and Josef Havel. Generation $\text{Ag}_p\text{Au}_q\text{Te}_r$ clusters via laser ablation synthesis using novel Ag-Au-Te nano-composite as precursor. Laser desorption ionization with quadrupole ion trap time-of-flight mass spectrometry. *Rapid Commun. Mass Spectrom.* 2014, 28, 1601–1608.

[3] Ravi Mawale, Milan Alberti, Zhang Bo, Max Fraenkl, Tomas Wagner, Josef Havel. The structure elucidation of AgAsS₂ glass by the analysis of clusters formed during Laser Desorption Ionisation applying QIT time-of-flight mass spectrometry. *Rapid Commun. Mass Spectrom.* 2016, 30, 594–602.

[4] Ravi Mawale, Mayuri Vilas Ausekar, David Pavliňák, Oleksandr Galmiz, Pavel Kubáček, Josef Havel. Laser Desorption Ionization Quadrupole Ion Trap Time-of-Flight Mass Spectrometry of $\text{Au}_m\text{Fe}_n^{+/-}$ Clusters Generated from Gold-Iron Nanoparticles and their Giant Nanoflowers. *Electrochemical and/or Plasma Assisted Synthesis. J. Am. Soc. Mass Spectrom.* 2017, 28, 215-223.