

## LECTURE

### APPLICATIONS OF MASS SPECTROMETRY IN BIOMEDICAL RESEARCH

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Mass spectrometry (MS) is an analytical technique that is based on ionization of chemical species and their subsequent separation according mass to charge ratio ( $m/z$ ). It has become an essential analytical tool in biological research and can be used for rapid and sensitive detection a wide variety of biomolecules such as peptides, proteins, oligosaccharides, lipids, DNA, and RNA), drugs, and metabolites. Among the most frequently ionization techniques used in biomedical field are Matrix-Assisted Laser Desorption Ionization (MALDI) and nanoparticles based Surface-Assisted Laser Desorption Ionization (SALDI).

The lecture summarizes and comments three works:

- (i) An overview about the classical histological staining methods and special visualization techniques for the purpose of tissue imaging, the use of various nanoparticles as visualization agents, application of MALDI TOF MS in tissue analysis, and the possibilities of using nanoparticles in imaging MS was published in the monograph [1].
- (ii) The effect of gold nanoparticles with a flower-like shape on ionization of various peptides by using MALDI TOF MS was studied. Comparison of the conventional MALDI method and methods with flower-like AuNPs and flower-like AuNPs combined with classical matrices was carried out. The use of flower-like AuNPs in MS increases overall quality of mass spectra like intensity, signal-to-noise ratio, reproducibility, resolution and limit of detection of biomolecules [2].
- (iii) The possibility of using clusters of monoisotopic elements like gold ( $Au_m^+$  and  $Au_m^-$ ) or phosphorus ( $P_m^+$  and  $P_m^-$ ) for external/internal calibration of mass spectrometers with TOF and Q-TOF analyzer was studied. Simple and fast method for LDI generation of gold clusters (with sufficient signal to noise ratio) enabled precise calibration up to high mass values - up to  $m/z$  17 000 for positive and to  $m/z$  6000 in negative ion modes [3].

#### References

- [1] Kolářová, L., Vaňhara, P., Peña-Méndez, E. M., Hampl, A., and Havel, J., Tissue visualization mediated by nanoparticles: from tissue staining to mass spectrometry tissue profiling and imaging. In A. Seifalian, de M. Achala, and D. M. Kalaskar, eds. *Nanomedicine*. Manchester: One Central Press, pp. 467–489 (2014).
- [2] Kolářová, L., Kučera, L., Vaňhara, P., Hampl, A., and Havel, J., Use of flower-like gold nanoparticles in time-of-flight mass spectrometry. *Rapid Commun. Mass Spectrom.* 29(17), pp.1585–1595 (2015).
- [3] Kolářová, L., Prokeš, L., Kučera, L., Hampl, A., Peña-Méndez, E. M., Vaňhara, P., and Havel, J., Clusters of Monoisotopic Elements for Calibration in (TOF) Mass Spectrometry. *J. Am. Soc. Mass Spectrom.* 28(3), pp. 419–427 (2016).