Mass spectrometry is a relatively new technique, however, has already found many applications, including in clinical diagnosis of diseases such as Alzheimer's and various types of cancer. Most of the previously published work related to the analysis of peptides, proteins and other compounds with a high molecular weight. However, study of low molecular weight compounds has a high potential. In the last year's metallic nanoparticles, especially gold nanoparticles have attracted the attention of researchers due to their unique properties. Among the various metal nanoparticles, gold nanoparticles are the most frequently applied in SALDI-MS.

Advantages of using gold nanoparticles are:

- simplicity of synthesis and modification of AuNP surface,
- high chemical stability,
- very high UV absorption coefficients.

The main disadvantages methods using AuNPs in suspension are that the efficiency of energy transfer for desorption and ionization processes seems to be strongly dependent on the particular molecule detected, and thus changes as a function of the specific nanomaterial–analyte combination. Moreover, the use of additives, for example salts, buffers, and proton donors, is often an essential requirement in order to achieve satisfactory ionization yield.

Research proposed in the project, will be a significant progress in comparison with currently used matrix-free systems that often have problems with aggregation of metal nanoparticles and as a consequence their uneven distribution.

The main objective of the project is to perform researches on new surface-assisted laser desorption/ionization (SALDI) mass spectrometry methods. Realization of the project will produce optimal procedure for synthesis of gold nanoparticles on steel target giving new matrix-free method applicable in analysis of complex mixtures and MS imaging of various objects via unique surface transfer.

The important feature of the project, from the point of view analysis of low-molecular weight compounds, will be the possibility to use metallic nanoparticles, in particular nanoparticles of gold and monoisotopic silver-109 of a predetermined size and shape. New matrix-free systems will allow measurements of maximum molecular weight 3000 Da or above and without interfering peaks, with precise internal calibration applied, thus it will facilitate interpretation and speed-up analysis.

The proposed research project will focus on:

- achieving of high level of coverage of target with metallic nanoparticles,
- homogeneous deposition of metallic nanoparticles on the steel surface,
- reaching highest possible spatial resolution and spectrum resolution,
- reaching highest possible detection sensitivity (lowest LOD – limit of detection).

Realization of the project will allow to optimization AuNPET method and to develop hybrid method AuNPET/^{109}AgNPET, applicable in analysis of complex mixtures and MS imaging of various objects via unique surface transfer. New method will be used for MS analysis of biological mixtures and MS imaging (MSI) and biological objects.

The proposed research methodology in the project has not been previously described in literature. Therefore this research should significantly expand knowledge in biochemistry, forensics, medicine and mass spectrometry field.