Investigation of nanoparticle enhanced emission in laser induced X-ray spectroscopy (NE-LIXS)

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In analytical Chemistry, fast measurements and easy sample preparation are two important factors for a method for the investigation of solid surfaces. One technique that fulfils these requirements is Laser Induced Breakdown Spectroscopy (LIBS). In recent years it was found out that the emission signal can be increased by coating the sample with a thin layer of gold or silver nanoparticles.[1] This technique is called NELIBS (nanoparticle enhanced LIBS). The emission signal enhancement through nanoparticles depends on the distance between the nanoparti-cles on the surface and can be controlled by the concentration of the used nanoparticle solution to coat the sam-ple.[2] This pre-treatment of the sample further enhanced the capabilities of LIBS by allowing the elemental quan-tification at ppb levels with a single laser shot.[3]
In our study, we investigate the same phenomenon in the wavelength region of 5 to 20nm using Laser Induced X-ray Spectroscopy (LIXS) to determine if this technique of emission signal enhancement can also be used for LIXS. Our experimental setup can be seen in Figure 1. We will prepare samples with different gold nanoparticle concen-tration and use 10nm, 50nm, 100nm and 200nm sized nanoparticles and determine the optimal concentration for each size for the emission signal enhancement. Additionally we will compare and investigate the signal enhance-ment achieved with NELIBS.

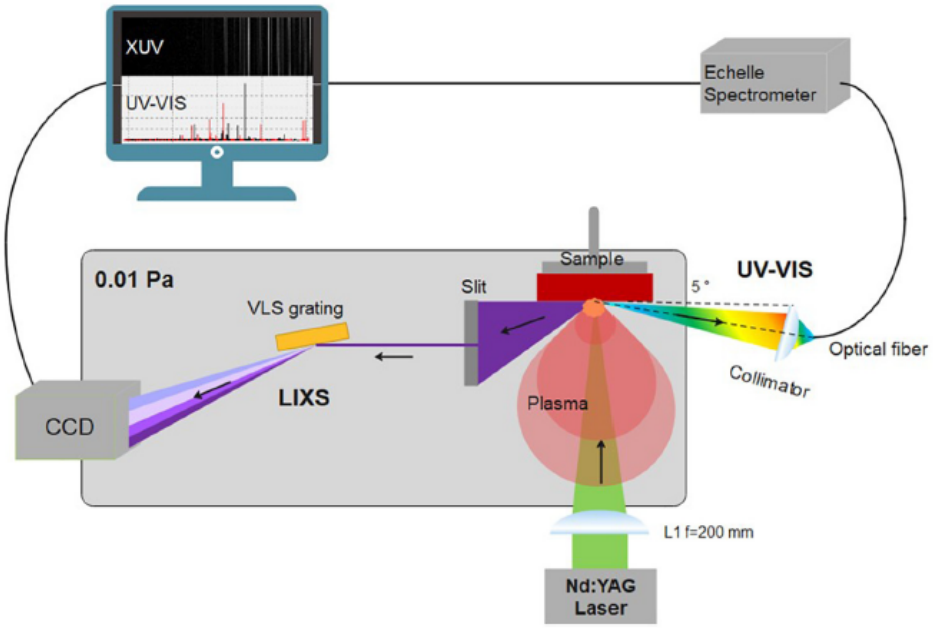

Figure 1: Experimental setup of the LIXS setup. Wavelength is 532nm of a Nd:YAG Laser focused with a lens onto the target. The target and spectrometer is placed in a vacuum chamber and the XUV (and also UV-Vis) signal are collected radially using a fiber optic and CCD camera.[4]

[1] M. Dell'Aglio, R. Alrifai, A. De Giacomo, *Spectrochim. Acta B* 2018, 148, 105-112.
[2] A. De Giacomo, M. Dell'Aglio, R. Gaudiuso, C. Koral, G. Valenza, *J. Anal. At. Spectrom.* **2016**, 31, 1566.
[3] Z. Salajkovà, V. Gardette, J. Kaiser, M. Dell'Aglio, A. De Giacomo, *Spectrochim Acta B* 2021, 179 16105.
[4] D. Qu, N. Ohannessian, C. Wyder, M. Trottmann, A. Wichser, T. Lippert, D. Bleiner, *Spectrochim. Acta B* **2021**, 181, 106214.