Chapter 52
Fundamental Study and Analytical Applications of Nanoparticle-Enhanced Laser-Induced Breakdown Spectroscopy (NELIBS) of Metals, Semiconductors and Insulators

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Abstract Nanoparticle-Enhanced Laser-Induced Breakdown Spectroscopy (NELIBS) is a recently proposed method to efficiently increase the LIBS emission signal of metals up to 2 orders of magnitude, by depositing metal nanoparticles (NPs) on the sample surface (De Giacomo A, Gaudiuso R, Koral C, Dell'Aglio M, De Pascale O Anal Chem 85). This considerable emission enhancement has been ascribed to two effects: (1) an improvement in the ablation effect, and (2) a more efficient production of seed electrons by field emission, in turn due to the enhancement of the laser electromagnetic field induced by the NPs themselves (De Giacomo A, Gaudiuso R, Koral C, Dell'Aglio M, De Pascale O Acta Part B, 98).

Here, we report our investigations about the effect played by several experimental parameters, i.e., laser energy; laser spot diameter; concentration, dimension, and kind of nanoparticles (NPs) in the case of NELIBS of metals. We also discuss NELIBS of non-metallic samples, whose emission enhancement is lower (up to 2–3 times) and follows a different mechanism. A special case of particular interest is that of transparent media, which can be efficiently made more absorptive by NP

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deposition. Moreover, we demonstrated the suitability of NELIBS to quantitative analysis of various samples (metals, alloys and non-metallic samples), both with the classical approach f calibration lines, and with calibration-free methods.

References

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2. De Giacomo, A., Gaudiuso, R., Koral, C., Dell'Aglio, M., De Pascale, O., Nanoparticle Enhanced Laser Induced Breakdown Spectroscopy (NELIBS): effect of nanoparticles deposited on sample surface on laser ablation and plasma emission, *Spectrochim. Acta Part B,* 98.