Laser-induced breakdown spectroscopy with laser pulses in the interval between 35 fs – 4 ps

S. Manzoor, J.M. Vadillo and J. J. Laserna

Universidad de Málaga, Departamento de Química Analítica, 29071 Málaga, Spain

This works presents the laser ablation studies for metals such as Chromium, Titanium, Iron and Copper by ultrashort laser pulses. The mechanisms and timeline of events in case of irradiation by ultrashort laser pulses are significantly different from longer laser pulses, due to the extent of interaction between the laser pulse and the expanding plasma to a point where the mass transfer does occur. Since these events in case of femtosecond laser ablation are well separated temporally [1], these can be visualized and demonstrated by the time-resolved spectroscopy where the formation of the dynamic Newton rings translate the ongoing processes [2,3]. The timeline of the laser ablation starts in femtoseconds scale where the laser pulse impinges the surface, passing through the picoseconds scale where the electron – lattice relaxation occurs and finally in the nanosecond range causing the mass transfer and sample cooling [4]. Therefore, one of the important factors that control these events is the laser pulse width, which has been made the focus of this study. A Ti:Sapphire oscillator providing a laser beam centered at 800 nm was used, with the pulse width range between 35 fs to 4 ps. Measurements were made on the metal samples to study influence of duration of the laser pulses on the emission lines, threshold fluence, plasma parameters and depth profiles. Furthermore, the evolution of plasma and spectral lines were also studied at each pulse width value.

References

1. Rethfeld, B., Sokolowski-Tinten, K., von der Linde, D. et al. Applied Physics A. 79 (2004) 767. https://doi.org/10.1007/s00339-004-2805-9
2. I.Carrasco-García, J. M.Vadillo, J.J. Laserna, Spectrochimica Acta Part B: Atomic Spectroscopy, Volume 113 (2015) 30-36
3. I.Carrasco-García, J. M.Vadillo, J.J. Laserna, J. Anal. At. Spectrom, 34 (2019) 2119 – 2125
4. Roth J., Trichet C., Trebin HR., Sonntag S. (2011) Laser Ablation of Metals. In: Nagel W., Kröner D., Resch M. (eds) High Performance Computing in Science and Engineering '10. Springer, Berlin, Heidelberg