Seminario de Química Física

Jueves 5 de febrero – 11:30 h

Sala de Tesis (Antigua Capilla)

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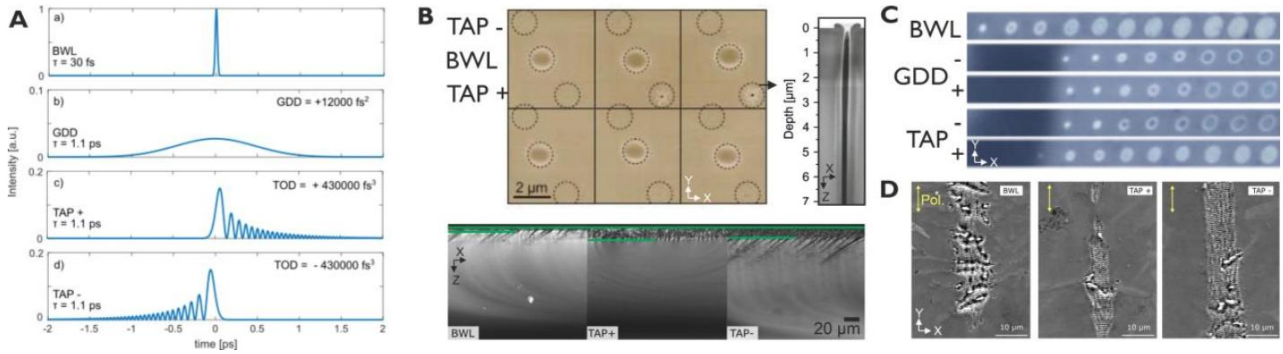
Temporally shaped femtosecond pulses for high resolution materials processing

The modification of materials with femtosecond laser pulses is becoming a mainstream processing technique for selected applications due to the high lateral resolution modifications that are possible to achieve. This is possible mainly thanks to the nonlinear absorption mechanisms that are triggered when the characteristic high-power peaks interact with the subject material. Traditional direct-write laser systems employ nominal bandwidthlimited pulses which typically display Gaussian temporal profiles, resulting most of the time in crater shaped modifications at the surface level in dielectric, semiconductor and metallic materials. Advancements in temporal pulse shaping techniques [1-3] have demonstrated significant improvements with regards to the final size and depth increasing the overall ablation efficiency and final lateral resolution. In this work, we present a survey that includes the formation micro- and nanometric size modifications in dielectrics, semiconductors and metals induced by temporally shaped femtosecond laser pulses coming from an amplified Ti:Sapphire femtosecond laser system operating at 1 kHz, nominal wavelength of 790 nm and pulse duration of 30 fs. Examples and applications are presented for different material types. These results highlight the critical role of temporal pulse shaping in controlling laser-material interactions and open new pathways for high-precision material processing across various disciplines and fields of application.



(A) Intensity profiles of the temporally shaped laser pulses implemented for the irradiation of (B) fused silica (top [2]) and soda lime glass (bottom [3]), (C) crystalline silicon <111>, and (D) AlSi10Mg alloy.

[1] L. Englert, B. Rethfeld, L. Haag, M. Wollenhaupt, C. Sarpe-Tudoran, T. Baumert, Optics Express, 15, 26, 17855-17862 (2007)
[2] N. Götte, T. Winkler, T. Meinl, T. Kusserow, B. Zielinski, C. Sarpe, A. Senftleben, H. Hillmer, T. Baumert, Optica, 3, 389-395 (2016)
[3] M.-S. Radu, C. Sarpe, E. R. Ciobotea, B. Zielinski, R. Constantinescu, T. Baumert and C. Florian, Zeitschrift für Physikalische Chemie, (2024)