Technical University of Denmark

Pulsed laser deposition (PLD) of dielectrics – is femtosecond laser ablation better than nanosecond ablation

Schou, Jørgen; Canulescu, Stela

Publication date:
2014

Document Version
Peer reviewed version

Citation (APA):
Schou, J., & Canulescu, S. (2014). Pulsed laser deposition (PLD) of dielectrics – is femtosecond laser ablation better than nanosecond ablation.

Pulsed laser deposition (PLD) of dielectrics – is femtosecond laser ablation better than nanosecond ablation?

Jørgen Schou and Stela Canulescu, DTU Fotonik, Risø Campus, Technical University of Denmark, DK-4000 Roskilde, Denmark

Pulsed laser deposition is a frequently employed method to produce films of materials, ranging from simple single-element metals to complicated oxides, including dielectric materials [1]. The films have traditionally been produced by nanosecond laser irradiation, but recently femtosecond lasers have turned out to be a feasible alternative to nanosecond lasers. The advantage of using femtosecond lasers is that the impact zone is heated so rapidly that essentially no energy is lost to the surroundings by heat conduction during the laser pulse, and that the plume is generated after the termination of the pulse. It means that the laser light is not absorbed or scattered in the plume in strong contrast to the laser light during nanosecond ablation. The characteristics of the ejected atomic particles are partly similar, e.g. with respect to plume particle velocities, but the plume is much narrower for femtosecond laser ablation. In contrast to nanosecond laser ablation the dominant part of the ablated particles for femtosecond laser are ejected as nanoparticles of diameter up 10-50 nm, which actually serves as a new “dry” method of fabricating these particles. While these points also apply to metals and other conductive materials, femtosecond laser pulses can be absorbed for photon energies below the band gap, since multi photon processes may occur for even moderately high intensities. However, a widespread use of femtosecond lasers for PLD of materials including dielectrics does require femtosecond laser systems that are commercially competitive with the existing nanosecond laser systems.

[1] P. Balling and J. Schou. Rep. Prog. Phys. **76**, 036502, 1-39 (2013).