FEMTOSECOND LASER POLISHING AND ABLATION OF SILICON CARBIDE WAFERS

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Silicon carbide (SiC) has become a critical material in the fabrication of SiC wafers for electronic applications, especially power semiconductor applications, due to its exceptional thermal resistance, extended operational lifespan, and high energy efficiency. One of the key steps in SiC wafer fabrication is chemical mechanical polishing (CMP). However, CMP has several drawbacks, including high cost, low material removal rate, contamination risk, and environmental and chemical waste concerns.

Laser polishing is an alternative technique for reducing surface roughness by inducing molten and re-solidified layers. It is environmentally friendly as it does not require chemicals, pads, or slurries. Therefore, laser polishing could minimize costs and errors when smoothing the surface of such materials.

In this research, a thorough investigation of SiC wafer polishing and ablation using a femtosecond GHz burst laser (Carbide, Light Conversion). This study aimed to optimize laser processing parameters to achieve the lowest possible surface roughness and the highest ablation efficiency. For this task, smart optimisation techniques were employed allowing to find the optimal laser fluence for the highest ablation efficiency and reach the surface roughness below the initial one [1, 2].

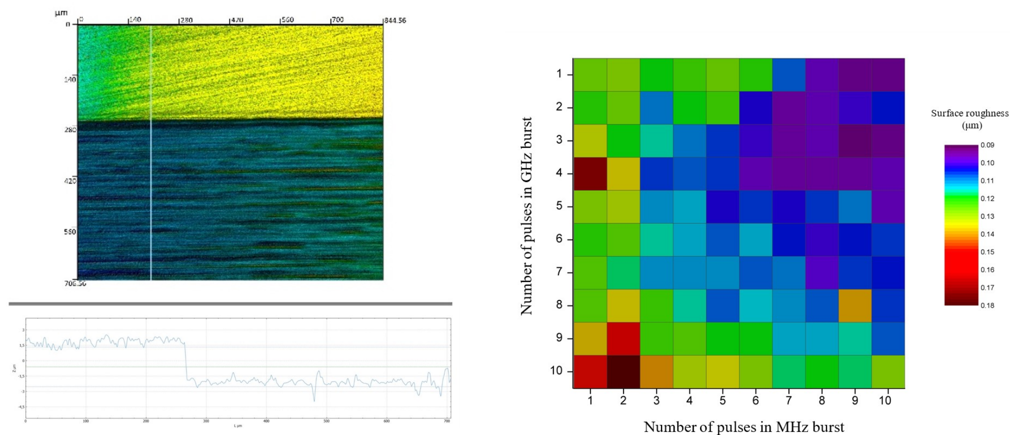

Fig. 1. Profilometeric image of half-ablated SiC surface (left); surface roughness of laser ablated SiC versus number of pulses in MHz and GHz bursts, scan speed 500 mm/s, line spacing 10 µm, laser fluence 0.84 J/cm^2 (right).

[1] [1] A. Žemaitis, U. Gudauskytė, S. Steponavičiūtė, P. Gečys, and M. Gedvilas, The ultrafast burst laser ablation of metals: Speed and quality come together, Opt. Laser Technol., 180, (2025), doi: 10.1016/j.optlastec.2024.111458.

[2] A. Žemaitis, P. Gečys, and M. Gedvilas, Efficient Ablation, further GHz Burst Polishing, and Surface Texturing by Ultrafast Laser, Adv. Eng. Mater., 26(21), p. 2302262, (2024), doi: https://doi.org/10.1002/adem.202302262.