Laser-plasma assisted ablation of SiC

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Owing to its unique physical properties, silicon carbide (SiC) is promising material for appliations in power electronics, MEMS, nanophotonics and nanoelectronics [1]. One of the effective techniques of SiC processing is laser ablation [2]. Strongly depending on parameters of laser irradiation, the thikness of the removed layer at laser ablation achives ~ 1 μm per 200 ns pulse [3], which is much more efficient than beam methods, but still insufficient for industrial implementation. Therefore, a logical direction is development of new processing methods for SiC, combining laser and plasma. In this paper, we demonstrate a new laser-plasma ablation method.
This work is devoted to consideration of the effect of IR nanosecond pulses (1064 nm, 200 ns, 1 mJ) on a 6H-SiC wafer ($\sim$ 340 μm), which was located on a polished graphite substrate. The sample was transparent for the laser wavelength. When focusing into a 50 μm spot on the SiC surface or either on the graphite substrate, part of the radiation initiated the carbon plasma. As a result of using this technique, ablation craters were formed both on the upper and lower surfaces of the SiC wafer with a depth of 0.5—2 μm under reaction of the single pulse. A lower energy density was required for the appearance of silicon lines, which indicates a selective mechanism of SiC ablation by a near-IR laser. In addition, a C_2 molecule band (a system of Swan bands) was observed in the plasma plume, which can be explained by the recombination of excited carbon atoms both upon ablation of the outer surface of the SiC plate and upon ablation of a graphite target under the SiC plate.

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[2] Pawar P, Ballav R and Kumar A 2017 *Reviews on Advanced Materials Science* **51** 62–76

[3] Pecholt B, Gupta S and Molian P 2011 *Journal of Laser Applications* **23** 012008