

Formation of weld joints glass with silicon using by femtosecond laser pulses

M. A. Murzakov¹, N. N. Evtikhiev^{1,2}, I. V. Obronov¹ and D. M. Kataev¹

¹ LLC “IRE-POLUS” LTD, Department “Laser Technologies”
Bd. 5, 3 Vvedenskiy sq., Fryazino, Moscow Region, 141190, Russia
E-mail: clericfull@gmail.com

² National Research Nuclear University MEPhI (Moscow Engineering Physics Institute)
31 Kashirskoe shosse, Moscow, 115409, Russia

Received 1.08.2024; revised 19.08.2024; accepted 26.08.2024

The article presents experimental results on the formation of welded joints of glass and silicon under the action of a laser with a pulse duration of 230 fs. The results of measuring the geometry of welded seams of the glass-silicon joint are presented. It was noted that with an increase in the welding speed from 30 to 70 mm/s, the weld width increases from 100 to 180 μm , while the weld depth decreases from 100 to 80 μm . It was determined that stable formation of the glass-silicon joint is formed at a pulse energy in the range from 10 to 17 μJ . In the course of the work, the glass-silicon transition zone was studied using scanning electron microscopy (SEM). It was determined that strong bonds of glass and silicon are formed in the transition zone due to the diffusion of chemical elements of both materials.

Keywords: femtosecond laser, laser welding, ultrashort pulse (USP), glass-silicon joint, micro-structure.

REFERENCES

1. Wallis G. and Pomerantz D., J. Appl. Phys. **40** (10) (1969).
2. Carter R. M., Chen J., Shephard J. D., Thomson R. R. and Hand D. P., Appl. Opt. **53** (2014).
3. Horn A., Mingareev I., Werth A., Kachel M. and Brenk U., Appl. Phys. **93** (2008).
4. Nordin I. H. W., Okamoto Y., Okada A., Jiang H. and Sakagawa T., Appl. Phys. A. **122** (2016).
5. Jellison G. E. and Lowndes D. H., Appl. Phys. Lett. **41** (1982).
6. Rajkanan K., Singh R. and Shewcgun J., Solid State Electronics **22** (1979).
7. Stolberg K., Kremser B., Friedel S. and Atsuta Y., J. Laser Micro/Nanoeng. **2** (2007).
8. Murzakov M. A., Evtikhiev N. N., Grezev N. V., Kataev D. M., Shevelkina E. D., Kuznetsova D. Yu. and Patrino Zh. G., Laser Phys. Lett. **20** (2023).
9. Murzakov M. A., Evtikhiev N. N., Grezev N. V., Kataev D. M. and Shchekin A. S., Laser Phys. Lett. **21** (2024).
10. Murzakov M. A., Evtikhiev N. N., Grezev N. V., Kataev D. M., Antipov D. A. and Bindug D. V., Quantum electronics **1** (2024) [in Russian].
11. Eaton S. M. Thermal writing of photonic devices in glass and polymers by femtosecond lasers, Woodhead Publishing Limited, 2012.
12. Chambonneau M., Li Q., Blothe M., Arumugam S. V. and Nolte S., Advanced Photonics Research **4**, (2023).
13. Klimkov Yu. M., Mayorov V. S. and Horoshev M. V. Interaction of radiation with matter, Moscow, MIIGAK, 2014 [in Russian].