

## Abstract

In this project, we use 70-fs pulse in glass laser welding. Comparing with 300-fs pulse, it is proved that the short pulse can make the welded glass have higher adhesion. Therefore, we have reason to believe short pulse laser welding will have great advantage in future.

## Theory

Using the high-intensity laser to ionize the electrons in the glass by multiphoton ionization, then after avalanche effect caused by thermal effect the plasma will be formed. Finally, after plasma resolidification the bubble structure will be formed and the two glass sheets can be bounded.

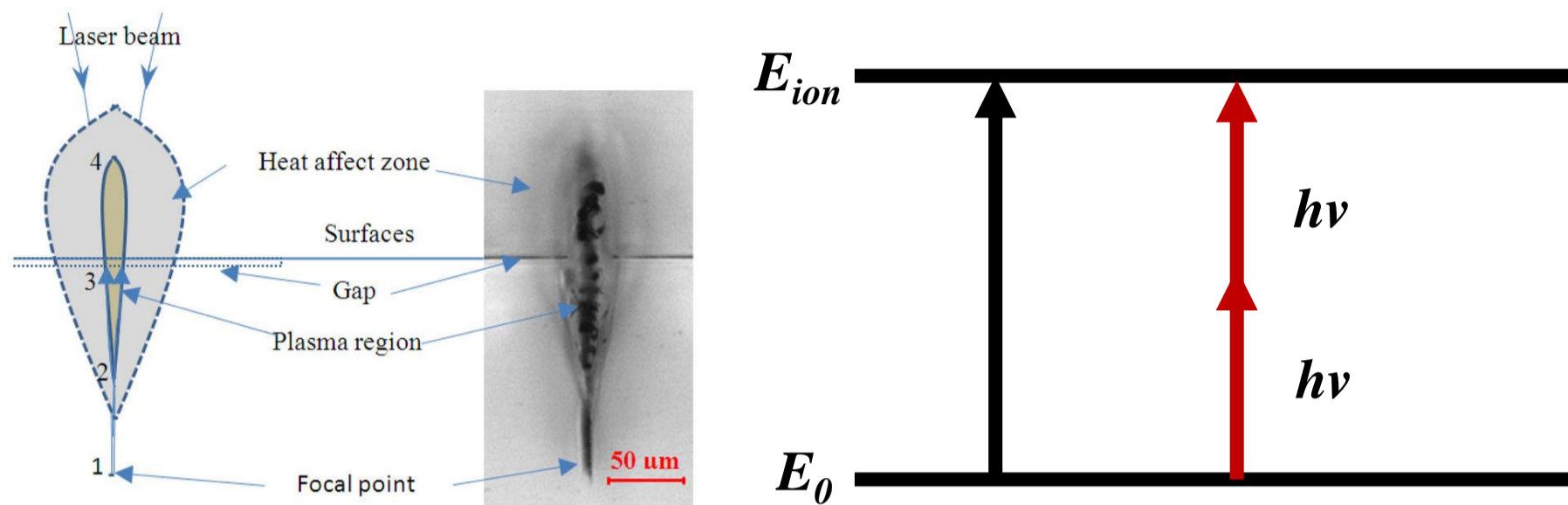


Fig. 1: Side view on laser welding samples<sup>[1]</sup> and schematic diagram of multiphoton ionization

## Setup

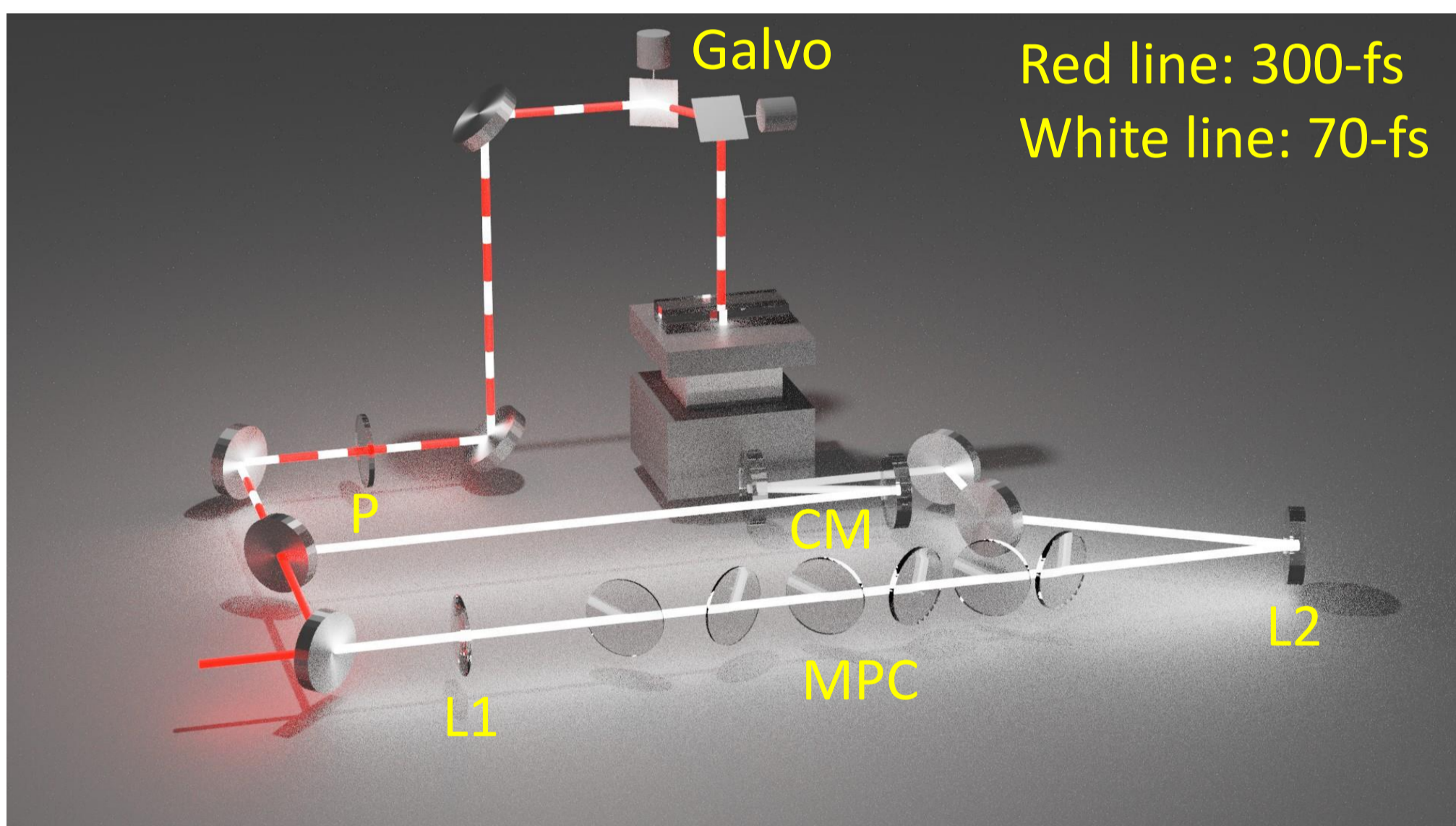


Fig. 2: The welding setup

P: polarizer. CM: chirped mirror. L1: convex lens. L2: concave lens. MPC: Multiple-plate Continuum<sup>[2]</sup>.

## Result

We use a 65 mm\*26 mm glass and a 26 mm\*15 mm glass sheet for welding, so it is more convenient to measure the adhesion of the finished product. The measurement method is to push from the side of the small piece of glass until the two pieces of glass are separated.

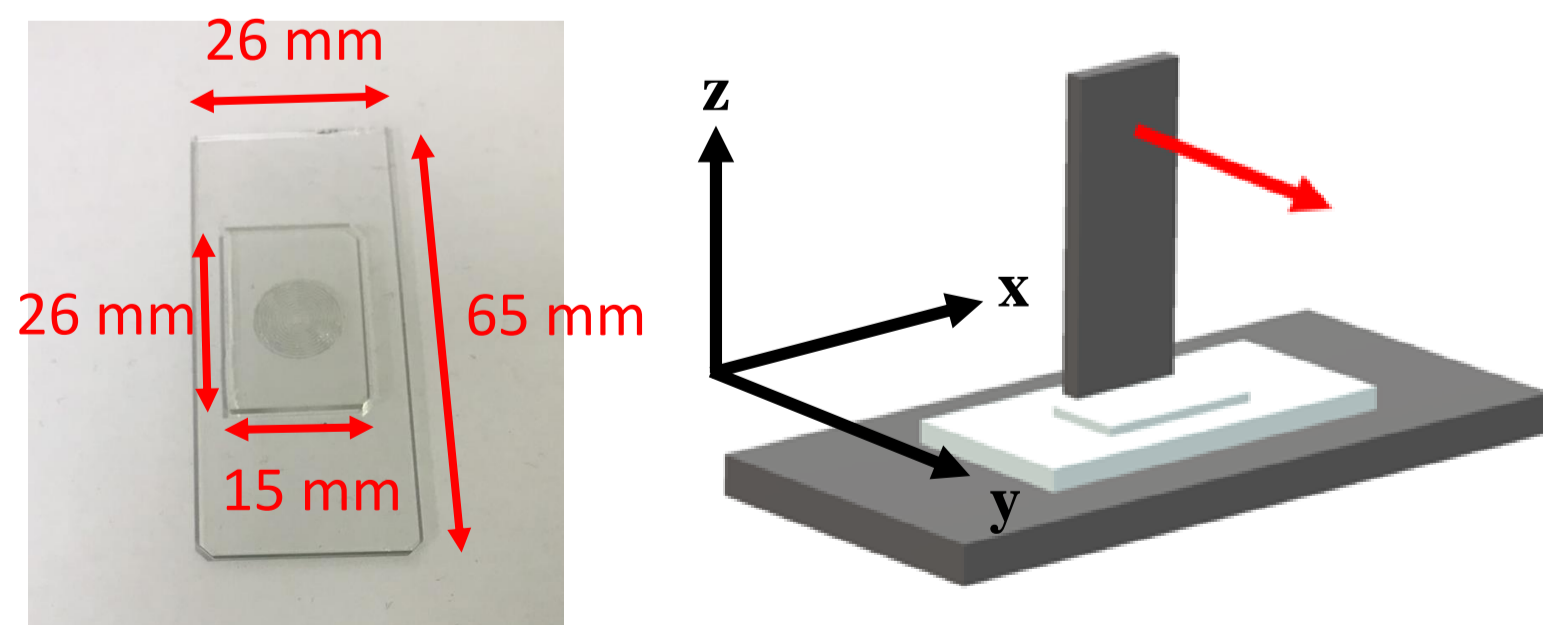


Fig. 3: The welding glass sheets and the schematic diagram of how we test the adhesion

Through the microscope, we can clearly observe the bubble structure at the junction of the glass sheets after welding.

The width of the bubble structure and the adhesion have a positive correlation. (R is the correlation coefficient)

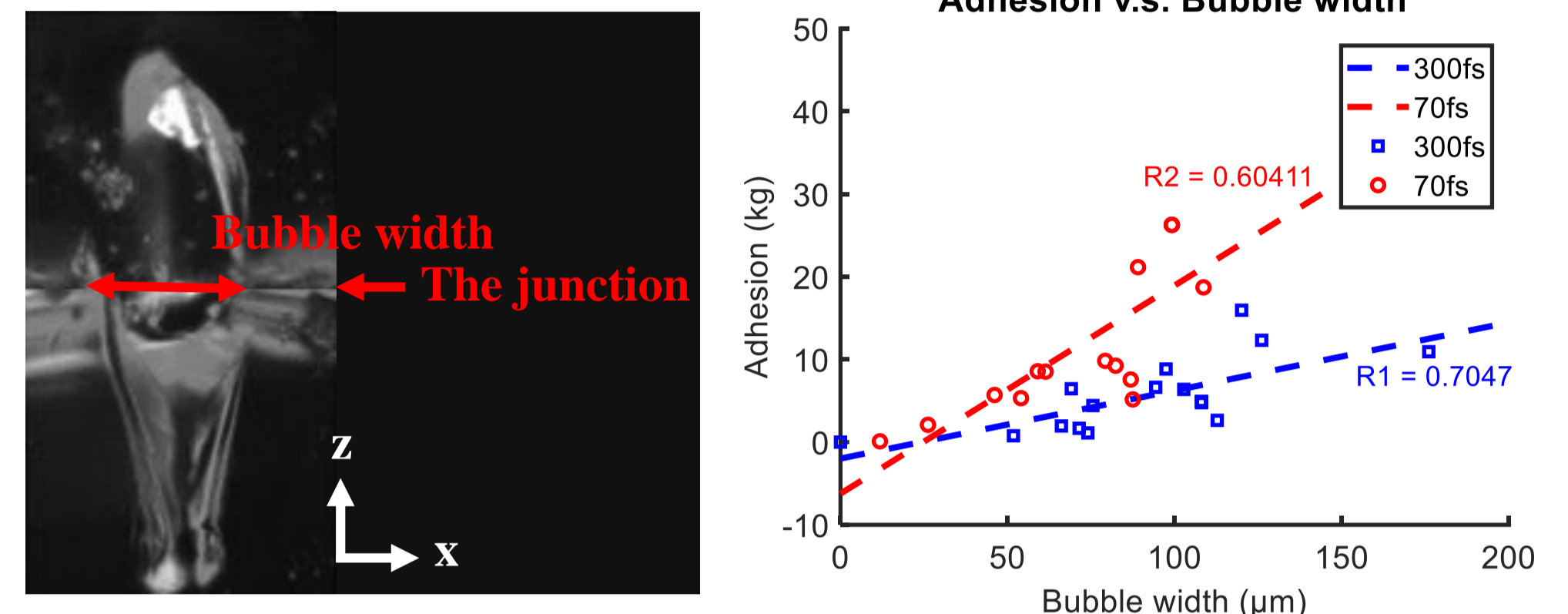


Fig. 4: The bubble structure at the junction and the relation between adhesion and bubble width

The higher the translation velocity of the laser during welding, the worse the adhesion. The higher the repetition rate, the stronger the adhesion. The relation between adhesion and pulse energy may need to do more research in the future.

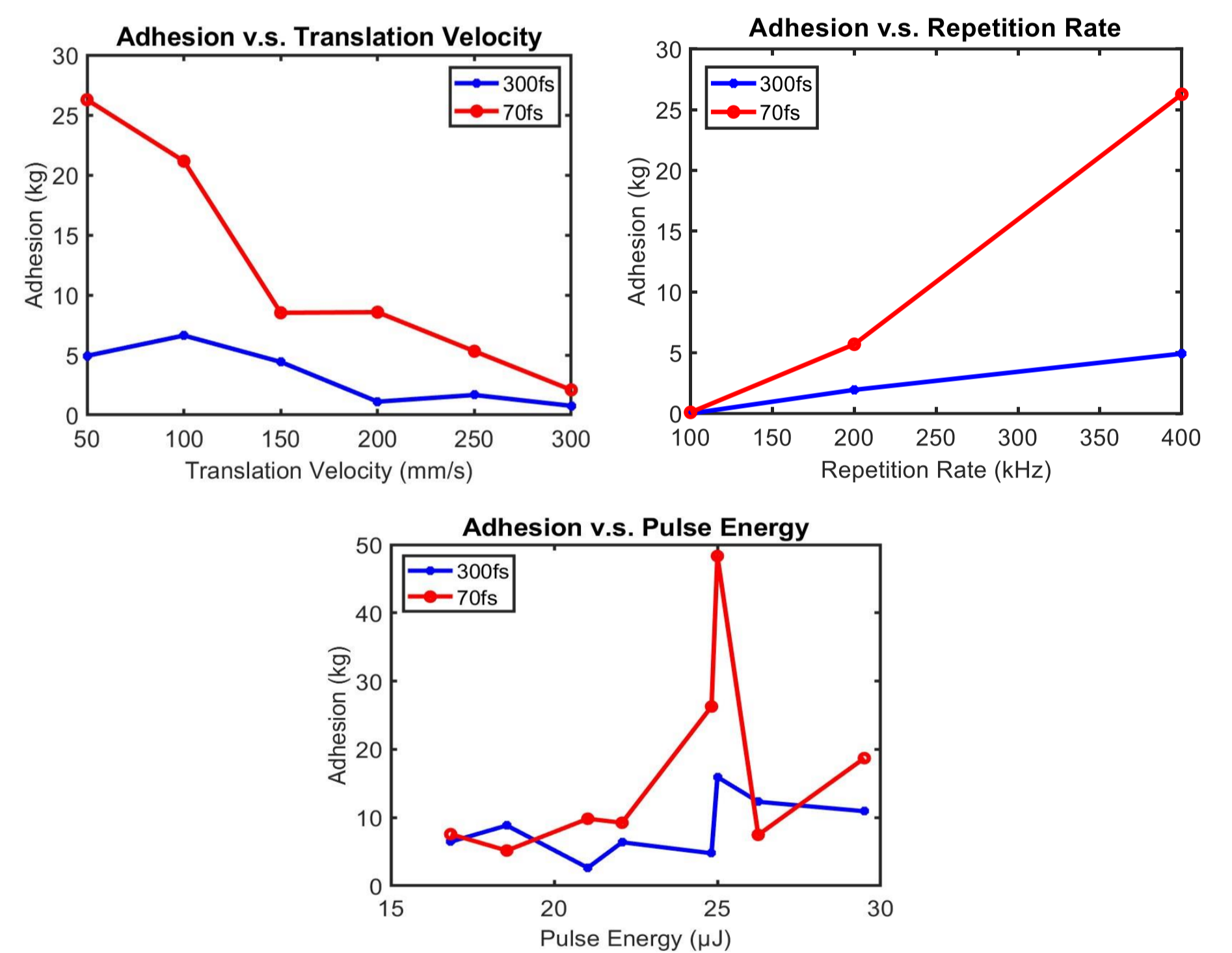


Fig. 5: Adhesion with different experimental parameters

## Summary

- 70-fs and 300-fs pulse laser are utilized to conduct glass welding experiments and adhesion properties have been studied.
- Short-pulsed laser is found to be more advantageous in glass welding.

## Reference

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- Chih-Hsuan Lu, Yu-Jung Tsou, Hong-Yu Chen, Bo-Han Chen, Yu-Chen Cheng, Shang-Da Yang, Ming-Chang Chen, Chia-Chen Hsu, A. H. Kung, "Generation of intense supercontinuum in condensed media," *Optica* 1, 400-406 (2014).



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