Microfluidics create a controlled micro-environment for biological cells, offering precise control over nutrient delivery, waste removal, and cell-cell interaction. Among various materials used for microfluidic fabrication, glass possess unique merits due to its superior optical transparency, chemical resistance, biocompatibility, and thermal stability, making it an ideal choice for cell culture and observation. Laser-induced selective etching (LISE) is a well-established technique for fabricating microfluidic channels in glasses. However, conventional LISE methods typically produce short channels, limiting its adoption in certain applications. To address the issue, we employ LISE with Bessel beams, which is used to cut channels through glasses with high efficiency. Using this method, We created channels that are 50-100 microns wide, and tens of millimeters long on thin cover glasses. The ultrafast laser precisely modifies the entire thickness of the glass substrate during cutting motion, the fabricated thin glass was then assembled to form a microfluidic device by sealing it between two glass slides using ultrafast laser welding, which eables a robust, hermetic, and optically transparent structure while maintaining the biocompatibility of the material. The resulting microfluidic system was validated for its application in 3D cell culture, demonstrating the system's capability to replicate three-dimensional cellular structures necessary for advanced biological studies. By leveraging the advantages of glass and the precision of ultrafast laser techniques, this work represents a step forward in the development of advanced microfluidic systems for next-generation biomedical research and diagnostics.

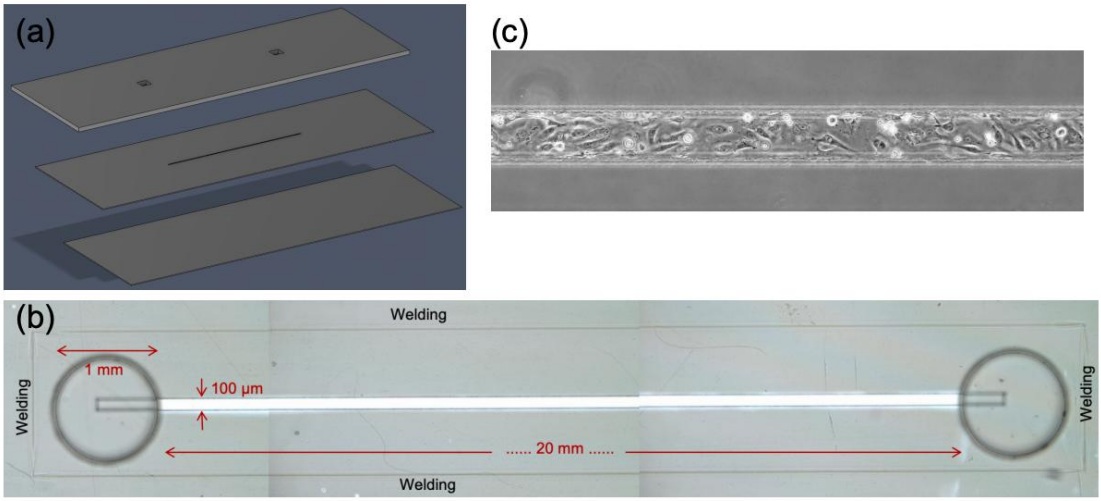

Figure 1. Straight microfluidic channel formed by ultrafast laser micro-cutting and welding. (a) Scheme of microfulidic channel by three pieces of glasses. (b) Microscopic image of fabricated microfluidics channel. (c) Microscope image of cells proliferating on the top side of the channel.