

Welding and cutting of glass to create support pillars for vacuum insulating glass: proof of principle

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Vacuum insulating glass (VIG) consists of two panes of window glass separated by a small gap that has been evacuated to minimise heat transfer and improve thermal efficiency in buildings [1]. An array of support pillars is an essential part of the design to prevent collapse due to the pressure differential between the internal vacuum and the external atmosphere [2,3]. Currently, miniature metal support pillars are used but their opacity leads to a visual obstruction, and due to their high thermal conductivity, they act as small thermal bridges which contribute to the heat transfer through the glass panes and therefore reduce the effectiveness of the glazing. A good alternative would be to replace the metal pillars with a transparent, low thermal conductivity material, such as glass; however, a suitably high speed and hence low-cost fabrication process is key for this consumer application.

Our solution is to exploit the ultra-short pulsed laser welding process [4] to bond thin flex glass to one of the glass panes, followed by a laser driven cutting/separation process to cut around each small weld region leaving an array of support pillars. As a proof of concept, soda-lime coverslip glass is directly bonded to a soda-lime microscope slide by laser welding with 5ps pulses, 500kHz repetition rate and 0.682W of average power. Here, the weld takes the form of a 1mm outer diameter Archimedean spiral. The pillar is formed by creating a circular cut of 1.2mm diameter around the weld using the same laser source but at 260fs with 10kHz repetition rate and 13.53W of average power. Indentation tests show that these pillars can withstand a compressive force greater than needed, assuming a 20x20mm² pillar spacing. For larger pillar separations, higher forces are required and although cracks occurred during our initial testing, the pillars remained intact showing promise for further development of this technique for the fabrication of glass support pillars for VIGs.

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