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Fracture Control of the Soda-Lime Glass in Laser Thermal Cleavage

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Abstract : The effects of the contact ball-lens on the soda lime glass in laser thermal cleavage with a cw Nd-YAG laser were investigated in this study. A contact ball-lens was adopted to generate a bending force on the crack formation of the soda-lime glass in the laser cutting process. The Nd-YAG laser beam (wavelength of 1064 nm) was focused through the ball-lens and transmitted to the soda-lime glass, which was coated with a carbon film on the surface with a bending force from a ball-lens to generate a tensile stress state on the surface cracking. The fracture was controlled by the contact ball-lens and a straight cutting was tested to demonstrate the feasibility. Experimental observations on the crack propagation from the leading edge, main section and trailing edge of the glass sheet were compared with various mechanical and thermal loadings. Further analyses on the stress under various laser powers and contact ball loadings were made to characterize the innovative technology. The results show that the distributions of the side crack at the leading and trailing edges are mainly dependent on the boundary condition, contact force, cutting speed and laser power. With the increase of the mechanical and thermal loadings, the region of the side cracks might be dramatically reduced with proper selection of the geometrical constraints. Therefore, the application of the contact ball-lens is a possible way to control the fracture in laser cleavage with improved cutting qualities.

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