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Drilling of crack free micro holes in glass by chemo-thermal micromachining process

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Abstract

Recent achievements made in the field of ceramics and glass technology demands the development of hybrid techniques to process those advanced materials precisely and efficiently. Chemo-thermal micromachining is a novel method of micro-fabrication, achieved by integrating laser based thermal ablation and chemical etching. This hybrid process involves focusing laser beam on a borosilicate glass specimen submerged in aqueous sodium hydroxide solution that causes chemical machining along with thermal ablation at the focused point. In this study, an attempt has been made to explore the effects of machining parameters like laser power, laser exposure duration and electrolyte concentration on material removal rate (MRR) and surface quality that involves study of surface cracks and built-up edges along the machined surface of borosilicate glass. A four-level full factorial experimental design was adopted to understand the effect of each parameter. Additional experiments have been conducted to identify the effect of laser and chemical machining separately. It was found that there was a reduction of about 90% in the average length of crack in chemo-thermal micromachining process as compared to laser ablation alone. Also, the number of cracks was reduced from about 20-23 in laser machining to 1-5 in this hybrid machining.

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