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Abstract

Laser Machining of Zirconia Green Compacts to Produce Cavities and Blocks: Parametric Optimization and Patterning †

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Zirconia is a very popular material among implants and prosthesis, due to its antibacterial activity, corrosion resistance and hardness properties. For these purposes, zirconia is to be sintered beforehand to obtain good dimensional and geometrical accuracy and then machined. However, the machining of sintered zirconia has always been a troublesome proposition, attributable to its extreme hardness.

The excellent properties of zirconia were applied in this study to the cutlery design. Nowadays, cutlery/flatware designs are constantly changing. However, for manufacturing, the traditional molding process remains widely popular, despite having huge limitations regarding aesthetic and design flexibility. In the present study, we explore a new horizon of cutlery design by patterning using laser surface modification. Blocks were laser machined from zirconia green compacts, which solved the machining problems associated with sintered zirconia, and then inserted into stainless-steel cutlery grooves to produce a novel aesthetical cutlery design.

This study addresses the parametric optimization of laser parameters (power, scanning speed and number of passages) to produce cavities in zirconia green compacts. Material removal, depth of cut, geometry and surface roughness were taken as output variables. For the analyses, a full factorial design of experiments was adopted. Moreover, this study provides the optimum parameters for the laser machining of zirconia green compacts to produce blocks with accurate dimensions and geometries. After laser machining the zirconia blocks, sintering was performed to achieve the desired dimensions.

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