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Cutting and extruding processing technology for ceramics based on edge-chipping effect

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Edge-chipping referred to the fact that the edges of hard, brittle materials are easily broken during processing. This problem has brought many difficulties to their quality control. In fact, it was that the machining process itself destroyed materials, even though it could be controlled. Based on this principle, a new machining technology based on crack propagation driven by edge-chipping effect was proposed here. Multiple flanges caused by the cutting could increase the number of edges. Additionally, the fracture defects were prefabricated on the surface of flanges. When the turning tool made of cemented carbide came into contact with the surface of the ceramics, under the intermittent impact. The fractures were generated on the sides of flanges contacted with the tool and the prefabricated micro cracks were expanded rapidly under this three-dimensional stress field applied externally by the tool. In addition, due to the stress release toward the free surface, the cracks would expand to the surfaces of newly generated edges and the chips would be broken off continuously, resulting in irregular edge-chipping and removal of material pieces. Furthermore, based on the spatial distribution of grayscale images, the surface quality after rough processing under the different conditions was reasonably reflected with the grayscale co-occurrence matrix (GLCM). With the new processing technology, these cracks became advantageous under specific conditions. Therefore, the high external energy and ultra-hard tools required for the traditional processing technologies could be significantly reduced and the ceramics could be removed with less energy consumption and the tools with the hardness of lower than its own one. Therefore, it not only could reduce the processing costs, but also could promote the extensive applications of engineering ceramic materials.

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Liquid precursor synthesis of lanthanum zirconate ceramics

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Liquid precursor for Lanthanum Zirconate ($La_2Zr_2O_7$) was synthesized by controlled cohydrolysis of $Zr(n\text{-}OC_3H_7)_4$ and acetylacetone–coordinated-yttrium compound. The liquid precursor featured adjustable viscosity and long shell life. FT-IR was measured to characterize the molecular structure of LZO to verify the coordination of acetylacetone to Zr or La atoms. TGA/DTG and XRD were utilized to investigate the thermal behavior of the precursor. The results showed the organic-to-inorganic transformation mainly happened at 450 to 800ºC. When the ceramization completed at 900ºC, $La_2Zr_2O_7$ powders were obtained with an average crystal size of less than 20nm. The microstructure of the prepared ceramic powders characterized by SEM-EDS showed the agglomerated particulates with a mean size of less than 20μm and a homogeneous elements distribution of Zr and La.

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