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Surface texturing of Si_3N_4–SiC ceramic tool components by pulsed laser machining

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Abstract

Traditional abrasive techniques such as grinding and lapping have long been used in the surface conditioning of engineering materials. However, in the processing of hard and brittle materials like silicon nitride (Si(sub3)N(sub4)), machining is often accompanied by numerous shortcomings which either lead to poor surface quality or residual surface damage of the workpiece. In this sense, this work focuses on the application of a pulsed mode, nanosecond Nd:YAG laser system for the surface texturing of Si(sub3)N(sub4)–SiC composites in the fabrication of machining tool inserts for various tribological applications. The samples were machined at varied laser energy (0.1–0.6 mJ) and lateral pulse overlap (50–88%) in order to generate a sequence of linear parallel micro-grooves on the sample surfaces. The results showed a logarithmic increase in material removal as pulse energy and lateral overlaps were increased. The material removal threshold was established at 0.1 mJ (0.78 × 10(sup5) J/m(sup2)). Optimum surface texturing was achieved at a combination of 0.3 mJ (2.38 × 10(sup5) J/m(sup2)) and 50%, pulse energy and lateral pulse overlap respectively.