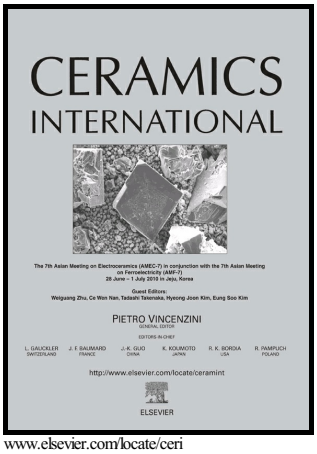

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Performance of Lightweight Coated Oxide Ceramic Composites for Industrial High Speed Wood Cutting Tools: A Step Closer to Market

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Abstract

The introduction of lightweight cutting tips in industrial wood machining could lead to machining at much higher speeds and thus greatly increase efficiency. One possible way to achieve this is through lightweight ceramic composites. An Al_2O_3 ceramic matrix was selected and reinforced with particles resulting in a density of approximately one quarter of the currently used heavy tungsten carbide tools (density of > 15 g/cm^3). Furthermore, a coating was applied to the ceramic cutting tools in order to increase the stability of the cutting edge. A combination of reduced coefficient of friction, frictional forces and a resulting decrease in temperature can lead to a reduction in chipping at the cutting tip. Chipping has always been the major drawback of ceramic cutting tools for industrial wood cutting. A ceramic composite containing 25 vol.% of submicron and nano sized SiC particles shows good mechanical properties with HV_2 = 21.5 GPa and K_{Ic} = 4.5 MPa m$^{1/2}$. This composition performed very well in industrial cutting trials on laminated beech. The cutting performance was increased further by use of an industrially available coating on the tools. The quality of the cut wood surface has always been difficult to characterize when comparing cutting tool materials and is often performed qualitatively by experienced carpenters by touch. The surface quality of the machined laminated beech was for the first time quantitatively characterized using Gelsight 2.5D tactile sensing.

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