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Experimental investigation on the material removal mechanism in during grinding silicon carbide ceramics with single diamond grain

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Highlights

- The single diamond grain grinding test was firstly proposed to decouple the effect of grinding speed and UCT on the SiC material removal mechanism during elevating the grinding wheel speed.
- The critical grinding wheel speed vs=100, 80, 80 m/s was determined at the agmax= 0.03, 0.3, 1μm respectively based on the effect of grinding wheel speed on the grinding force and subsurface morphology.
- The results demonstrated three grinding regimes: ductile, ductile-brittle, and brittle. Critical M-UCT values, such as 0.3,1 μm, were determined based on the surface and subsurface morphology, grinding forces, grinding energy to quantify the material removal modes.

Abstract A single grain grinding experiment with fixed speed ratio v_s/v_w was designed to decouple the effect of grinding speed and undeformed chip thickness (UCT) on the SiC material removal mechanism during elevating the grinding wheel speed. Ground surface and subsurface topography, grinding forces, and specific energy were measured with grinding speed ranging from 20 to 160 m/s and maximum UCT a_{gmax} from 0.02 to 3 μm. The results demonstrated the grinding force and specific grinding energy show an evident decreased tendency with the increasing of grinding speed, despite the a_{gmax} value was kept at 0.03, 1 μm. However, at a_{gmax}=0.3 μm, the grinding force has a peak value with the increment of grinding wheel speed. The subsurface has the same trend. Based on the subsurface morphologies, grinding forces, grinding energy, the critical grinding wheel speeds v_s=100, 80, 80 m/s were determined at the a_{gmax}= 0.03, 0.3, 1 μm,