Experimental investigation on single-asperity friction and wear of 4H-SiC

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Ultrasonic-assisted polishing（UAP）of silicon carbide（SiC）wafers can effectively improve processing efficiency and wafer surface quality, making it widely applied in the SiC semiconductor manufacturing industry. However, the potential of UAP has not been sufficiently developed because the mechanism of interaction between the single abrasive particle and the wafer surface is so far elusive. In this study, the single-asperity friction and wear behaviors of single crystal 4H-SiC against a pyramidal diamond AFM tip were quantitatively investigated with respect to the normal load under the presence and absence of ultrasonic vibration. The experimental results show that the ultrasonic vibration decreased the friction force across the entire range of normal loads during single-asperity sliding. With the increase in normal load, ultrasonic vibration enhanced the material removal rate by increasing the relative distance between the diamond tip and the SiC surface. After concluding, specific friction and material removal rate equations were proposed to clarify the interaction mechanism between the diamond tip and the SiC surface. The results would promote understanding the material removal mechanism in the ultrasonic-assisted polishing of SiC wafers.