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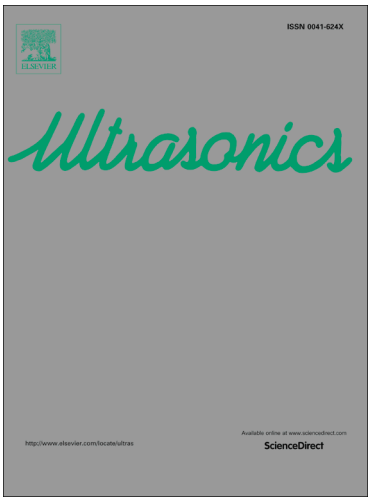

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Effect of ultrasound on dynamics characteristic of the cavitation bubble in grinding fluids during honing process

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Abstract: The effect of ultrasound on generating and controlling the cavitation bubble of the grinding fluid during ultrasonic vibration honing was investigated. The grinding fluid on the surface of the honing stone was measured by utilizing the digital microscope VHX-600ESO. Based on analyzing the cavitation mechanism of the grinding fluid, the bubble dynamics model under conventional honing (CH) and ultrasonic vibration honing (UVH) was established respectively. Difference of dynamic behaviors of the bubble between the cases in UVH and CH was compared respectively, and the effects of acoustic amplitude and ultrasonic frequency on the bubble dynamics were simulated numerically using the Runge-Kutta fourth order method with variable step size adaptive control. Finally, the cavitation intensity of grinding fluids under ultrasound was measured quantitatively using acoustimeter. The results showed that the grinding fluid subjected to ultrasound can generate many bubbles and further forms numerous groups of araneose cavitation bubbles on the surface of the honing stone. The oscillation of the bubble under UVH is more intense than the case under CH, and the maximum velocity of the bubble wall under UVH is higher two magnitudes than the case under CH. For lower acoustic amplitude, the dynamic behaviors of the bubble under UVH are similar to that case under CH. As increasing acoustic amplitude, the cavitation intensity of the bubble is growing increased. Honing pressure has an inhabitation effect on cavitation effect of the grinding fluid. The perfect performance of cavitation of the grinding fluid can be obtained when the device of UVH is in the resonance. However, the cavitation intensity of the grinding fluid can be growing weakened with increasing ultrasonic frequency, when the device of UVH is in the off-resonance. The experimental results agree with the theoretical and numerical analysis, which provides a method for exploring applications of the cavitation effect in ultrasonic assisted machining.

Keywords: Ultrasound ; Cavitation; Honing; Bubble; Dynamics model

1. Introduction

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