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A Fundamental Experiment for Micro Ultrasonic Knurling Technology Creating High Precision Texture on Sliding Surface

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Abstract

Sliding surface in mechanical system is required to move smoothly and stop at target position. Sliding surface can move and stop by applying adequate friction force. Friction force is controlled by developing technology creating small texture on the surface with a few to a few hundred micrometer intervals. If friction force is reduced by applying this technology to large area sliding surface of airplanes, generators and machine tools, so on, the machining effect drastically improves. It is necessary to develop machining technology to create texture with high precision and efficiency. On the other hand, ultrasonic vibration is used in many manufacturing fields. It is well known that surface roughness is improved and stress is reduced using ultrasonic vibration. In this study, machining technology creating wear resistant texture on large area sliding surface with high precision and efficiency using ultrasonic vibration during knurling is developed. In this paper, effect of ultrasonic vibration is examined by the fundamental experiment. A horn to amplify ultrasonic vibration is designed and made. Frequency of ultrasonic vibration is measured and it is found that desired frequency is available. In the experiment making a groove on the surface with an indenter using a 2 dimensional table, pressing force and friction force are measured. These forces are reduced using ultrasonic vibration. Pressing experiment making texture on the surface is also made. Deeper and clearer marks are formed using ultrasonic vibration during knurling for the specimen made of copper.

Key Words: Knurling, Ultrasonic vibration, Texture, Pressing force, Friction force

1. Introduction

Sliding surface of many machines is required to move smoothly. It is also required to stop at target position. Smooth moving and stopping of sliding surface is realized by giving adequate friction force. Friction force is controlled by creating groove with interval from a few to a few hundred micrometers. If this technology is applied to large industrial machines, for example, airplanes, generators, machine tools, and low friction force is realized, efficiency of machine drastically improves. For realization of low friction force, machining