

Thesis Title	Wire Drawing Process of Shape Memory Alloy by Applying Ultrasonic Vibration Technique
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Abstract

Many problems are found during drawing of orthodontic wires which made of shape memory alloys (SMA). Especially, in the case of fine wire, the rupture of the wire during drawing operation is always found because drawing resistance is relatively high compare to the strength of the wire. Moreover, the adhesion of material to the die surface due to insufficient lubrication can be easily occurred. This will cause the scratch on wire surface. In order to solve these problems, utilizing of ultrasonically vibrated die is proposed. Wire drawing equipment is designed in order that ultrasonic vibration (20 kHz) can be successfully exerted. This study aims to investigate the influence of vibration on the fabrication of rectangular cross-section arch wire. The workpiece material used in the experiment is $Ti_{49}Ni_{51}$ shape memory alloy wire, having initial diameter of 0.7 mm. The targeted cross section is rectangular shape whose dimension is 0.41×0.56 mm \times mm. Drawing speed is determined to be 10 mm/min. The die is made of tungsten carbide in a whole piece. As a results, in the first step of drawing, the drawing force decreases approximately 2.8% by exerting ultrasonic vibration. Furthermore, ultrasonic vibration provides the drawn wire with superior surface quality compared to that of conventional drawing. Work hardening over the wire cross section is more uniform for ultrasonic vibration drawing. However, second step drawing can not be accomplished because the stress in the wire is higher than the material strength. The experiments of using initial wires having diameter of 0.64 mm were also performed. Wire drawing can be completed for both

steps. Reduction of drawing forces and improvement of wire surface quality can be obtained with applying ultrasonic vibration.

Keywords: Wire drawing/ Ultrasonic vibration/ Shape memory alloy/ Arch wire/
Rectangular cross-section wire