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Horn design for ultrasonic vibration-aided equal channel angular pressing
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Abstract
This work focuses on the resonance frequency determination of a horn as a main part of ultrasonic vibrated equal channel angular pressing using experimental and simulated modal analyses. A stepped shape hot-work tool steel horn was successfully designed and manufactured to promote maximum punch force reduction. The resonance frequency of the system which includes the horn with an initial length of 220 mm was obtained by simulated modal analysis. Experimental work using Audio-Technica microphone on five different horn lengths at the free condition was developed to verify the simulated modal analysis. Also, the changes in frequency with the horn length were obtained experimentally. By considering both the system resonance frequency of 18,760 Hz for the horn length of 220 mm and 90 Hz change of longitudinal frequency for 1 mm of horn length, the final horn length was obtained to be 206 mm. Moreover, it was shown that the billet length has no considerable effect on the resonance frequency of the system. Finally, 9 % reduction at the required punch load was achieved by employment of ultrasonic vibration as compared to the conventional equal channel angular pressing process. © 2016, Springer-Verlag London.

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