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Measurement of elastic modulus and damping properties of friction stir processed pure metals using impulse excitation technique

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The Impulse Excitation Technique (IET) is one of the most reliable and a non-destructive technique to measure dynamic elastic properties of materials i.e. Young's modulus (E), shear modulus (G) and Poisson's ratio (υ). It is also possible to measure damping factor and resonant frequency of materials using this technique. In the current study, IET is used to measure the Young's modulus, natural or resonant frequency (f_r) and damping factor (Q^{-1}) of friction stir processed pure metals with an intention to assess their vibration damping ability. Commercial pure aluminium (Al), copper (Cu) and magnesium (Mg) metals were subjected to single pass friction stir processing employing 600RPM of tool rotational speed and 60mm/min of travel speed. The specimens for IET analysis and for microstructural observations were extracted from the stir zone of friction stir processed plates. The microstructure in the stir zone is severely refined by the friction stirring particularly the grain size of magnesium refined to 25.6μm from its initial size of 780μm. The measured Young's modulus and natural frequency for the processed Al and Cu samples was interestingly lower than their as-received counterpart. But the damping ability of these metals significantly improved after processing. However, for magnesium, the observed trends in the properties before and after processing were quiet opposite to the other two metals. The crystal defects created during the friction stirring could be a reason for the observed trends.

***Keywords*:** Impulse excitation technique (IET), resonance frequency and damping factor, friction stir processing.