

On the fracture of Al/NiTi composite manufactured by friction stir processing

Ly Zhao*, Aude Simar[‡], Sergio Turteltaub ⁺

* Université Catholique de Louvain, Louvain-la-Neuve, Belgium.
Email: lv.zhao@uclouvain.be

‡ Université Catholique de Louvain, Louvain-la-Neuve, Belgium.
Email: aude.simar@uclouvain.be

⁺ Delft University of Technology, Delft, The Netherlands.
Email: S.R.Turteltaub@tudelft.nl

Damage controlling involves a challenging issue in metal matrix composites due to the dominant failure at the interface between matrix and reinforcement agents. Shape memory alloys (SMAs) are considered good candidates to overcome this problem since they allow the creation of local compressive residual stresses that may delay fracture initiation. The present work investigates the fracture properties in friction stir processed Al1050/NiTi composite. Shape memory effect (SME) of the integrated NiTi particles was triggered by cold rolling and heat treatment to introduce local residual stresses. *In-situ* tensile tests were performed in a scanning electron microscope to study the fracture behaviors in both Al/NiTi and pure Al (also friction stir processed and cold rolled) samples. It is found that the Al/NiTi composite involves higher ultimate tensile strength than the pure Al. When looking at the crack propagation in the pre-cracked samples, we notice that the NiTi particles lead to fracture path deviation in the composite, conversely to the straight crack growth in the pure Al. Moreover, according to the fractographic analysis, a flat to slant fracture mode transition is found in Al/NiTi, in contrast to the fracture of pure Al in which only the so called “flip-flap” feature is observed. We propose that the strengthening effect comes from not only the shape memory effect of NiTi particles, but also some local stresses induced by the cold rolling in the heterogeneous Al/NiTi composite, as highlighted by finite element simulations.

Keywords: metal matrix composite, friction stir processing, fracture properties, shape memory alloys