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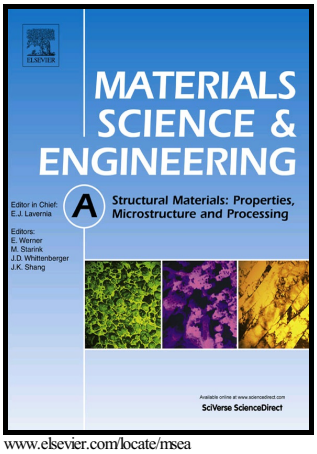

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PII: S0921-5093(18)30537-9
DOI: https://doi.org/10.1016/j.msea.2018.04.040
Reference: MSA36360

To appear in: *Materials Science & Engineering A*

Received date: 8 April 2018
Accepted date: 10 April 2018

Cite this article as: Hui Wang, Lihong Su, Hailiang Yu, Cheng Lu, A. Kiet Tieu, Yu Liu and Jie Zhang, A new finite element model for multi-cycle accumulative roll-bonding process and experiment verification, *Materials Science & Engineering A,* https://doi.org/10.1016/j.msea.2018.04.040

A new finite element model for multi-cycle accumulative roll-bonding process and experiment verification

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Abstract

The modelling of multi-cycle accumulative roll-bonding (ARB) is challenging due to the repetitive cutting, stacking and roll-bonding. In this study, a finite element model was proposed and by which the real ARB process was successfully simulated for 5 cycles for the first time. Mapping solution, a remeshing analysis technique, was adopted to transfer the deformation solution from the deformed mesh to a new mesh between cycles, which not only enabled the simulation of discontinuous processes, but also alleviated the mesh distortion. Moreover, with this technique, tensile tests of ARB processed materials were also simulated. The predictions have been validated by the corresponding experimental observations. The deformation behaviours, in terms of texture, hardness, tensile strength and fracture, and plasticity instability were studied. The evolution of shear strain explained the heterogeneity and transition of textures. The distribution of hardness was in the same pattern as equivalent plastic strain through the thickness at first and then it tended to be uniform due to microstructural saturation. The investigation of tensile fracture and plastic instability showed that their occurrence was related to the difference in strength between the two components of composites.

Keywords: accumulative roll-bonding; finite element method; hardness; tensile test; plastic instability; texture