Self-heating and fatigue of additively manufactured NiTi

Mahmoud Barati[1], Luc Saint-Sulpice*[1], Shabnam Arbab Chirani[1], Parisa Bayati[2], Mohammadreza Nematollahi[2], Mohammad Mahtabi[2], Ahmadreza Jahadakbar[2], and Mohammad Elahinia[2]

[1]Institut de Recherche Dupuy de Lôme (IRDL - UMR CNRS 6027) – Ecole Nationale d'Ingénieurs de Brest (ENIB) – France

[2]Dynamic and Smart Systems Laboratory, The University of Toledo (DSSL) – États-Unis

Résumé

NiTi as a shape memory alloy (SMA) benefits from unique functional properties, such as superelasticity and shape memory effect and could be a great candidate for different applications. However, due to the high reactivity, high hardness, and ductility, the conventional fabrication of NiTi is a challenging task, and therefore, the conventionally fabricated NiTi is only available in simple geometries [1]. Using additive manufacturing techniques to produce NiTi is a promising solution to this problem. Although additive manufacturing provides a flexibility in fabrication of complex geometries, properties of the material such as mechanical fatigue life might be affected by this process.

This study is focused on the fatigue and the self-heating properties of additively manufactured NiTi. Self-heating properties of the material are obtained using experimental measurements on NiTi dog bone samples under cyclic loadings at various amplitudes.

A two-scale model describing the probabilistic apparition of inelastic inclusions in an elastic matrix is developed based on a SMA behavior model [2]. It permits to reproduce self-heating results and then, by choosing an adapted fatigue criteria, is able to predict fatigue properties of the samples.

Then, these results have been validated using classic fatigue tests on hourglass samples. With this fast method, effects of additive manufacturing parameters on fatigue properties can be efficiently studied.

References

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*Intervenant

Mots-Clés: additive manufacture, NiTi, shape memory alloy, fatigue