MECHANICAL ENGINEERING STUDENT SEMINAR

Wednesday, October 9th, 2024, at 13:30, D. Dan and Betty Kahn Building, Room 217.
Online: https://technion.zoom.us/j/92100515991

Thermomechanical characterization of Additively Manufactured Ni-Ti SMA using solid-state process

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Shape memory alloys (SMA) are a subgroup of active materials, which have unique thermo-mechanical response. SMA exhibits two primary characteristics - Shape Memory effect (SME) and superelasticity (SE). The former refers to materials which can deform and return to their pre-deformed shape when heated, while the latter refers to large reversible strains – between 6%-10% upon a loading-unloading cycle. SMA are promising materials for numerous innovative applications in the fields of actuation, sensing, elastocaloric cooling, energy harvesting and energy absorption. Due to manufacturing difficulties, SMA are currently available in limited simple geometries, such as wires, rods and thin plates. This limitation hinders the development of SMA-based applications that require complex geometries. Additive manufacturing (AM) is a solution to this problem.

In this work, we want to show for the first time the feasibility of an innovative solid-state AM technology for fabricating NiTi SMA. The technology, called MoldJet, was developed recently by Tritone Technologies Ltd., an Israeli based company, and implemented to produce structural metals and alloys. The term solid-state implies that the feedstock remains solid during the printing process, thus allowing better microstructure control of the printed part. This contrasts conventional fusion-based additive manufacturing methods, such as LBPF or EBM, where the material is repeatedly melted and solidified.

Our findings indicate low contamination levels of oxygen and carbon compared to other conventional AM processes. In addition, high density is achieved due to sintering optimization. Thermo-mechanical properties, such as transformation temperatures, recoverable strain, irrecoverable plastic strain, and transformation stress, are evaluated and compared to NiTi fabricated using other AM processes.

In addition, we show promising potential of powder pretreatment using ball milling on the properties of AM metal parts. Our results indicate the ball milled powder exhibited higher sintered density at a lower sintering temperature and higher strength. While these results are demonstrated on NiTi SMA, the approach can be applied to any metal and any solid-state AM method.

Note: the seminar will be given in Hebrew

Seminars Coordinator: Assoc. Prof. Shmuel Gal