Direct current potential drop method for the identification of onset fatigue damage in triply periodic minimal surfaces lattice structures for heat exchange applications

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Abstract

The research activity presents a methodology for monitoring the onset of fatigue damage in Triply Periodic Minimal Surface (TPMS) lattice structures using the Direct Current Potential Drop (DCPD) technique. The aim of the study is to validate an experimental setup capable of interrupting a fatigue test at the early propagation phase, prior to crack propagation through the entire wall thickness, which represents the operational failure condition for TPMS-based heat exchangers. The DCPD technique is described in detail, including the modifications made to conventional testing setup, in order to consider the specific case of lattice structures. Additionally, the challenges encountered for these modifications and the strategies employed to overcome them are discussed. The validation of the proposed methodology is supported by a detailed analysis of the fracture surfaces of samples for which the test was interrupted using the DCPD technique. The results of the potential drop method are analysed and compared with common methods of fatigue test monitoring — i.e. axial stiffness drop.

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