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Title
Low cycle fatigue and creep properties of a new L-PBF additive manufacturing copper-maraging steel metal matrix composite for liquid rocket engine thrust chambers

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Abstract
Liquid rocket engine regenerative thrust chambers are a critical component of launch vehicles. Since the material behavior with respect to the temperature drives the stress–strain plastic behavior of the aforementioned hardware, it is of primary importance to select an adequate compromise between thermal conductivity and mechanical properties. An innovative metal matrix composite, processed by L-PBF additive manufacturing, is proposed. A patented innovative additive manufacturing powders mixing process is used to combine two different powders: 65% pure copper and 35% 174PH maraging stainless steel. Nowadays, the so called 'dog-house' cycling failure mechanism of thrust chambers is still under investigation by the scientific community since it is driven by multiple material behaviors: low cycle fatigue, creep end local plastic instability. The present work aims to present the high-temperature low-cycle-fatigue and creep properties investigated by an experimental activity performed on the new copper-maraging steel alloy. A new material behavior has been pointed out. It is a "local hill softening-hardening phenomenon", which is a time dependent activated damage which occurs during cycling and creep tests.
The new material manifest promising fatigue properties, acceptable thermal conductivity, low creep strain and excellent mechanical properties making it a potential competitor to some of the most famous and widely used additive-manufacturing, copper-based alloys for space propulsion such as GrCOP42,GrCOP84 or CuCrZn.