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# Producing Light Structures through Additive Manufacturing and Using Upcycled Feedstocks

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Weight reduction is crucial for transport industries (like aerospace), it is possible to achieve through topological optimization or by implementing lattice structures. This objective can be obtained by additive manufacturing processes. Besides, sustainability concerns are important and the use of upcycled powder feedstocks can be noteworthy. In the current study, we present an upcycling approach to produce metallic feedstock powders for additive manufacturing purposes. The construction of light structures is evaluated using two methodologies: 1) applying the Parametric Identification Process (PIP) as a computational method to evaluate the impact of density on the mechanical behaviour of printed materials; 2) implementing lattice structures to produce strong shallow walls.
Input materials used for this study involved commercial powders (AISI 316L and AlSi10Mg) and upcycled ones. Regarding the latter type, metallic chips received as machining by-products were transformed into powder feedstock by applying mechanical milling. It is a fusion-less solid-state process that uses less energy than the melting process. This upcycling method adds more value to MCs than downgrading. Powder characteristics are essential, which means, particle size distribution of 20 to 63 µm and 50 to 150 µm for direct energy deposition and powder bed fusion processes, respectively. However, the success of using a broader range (38 to 212 µm) with irregular-shaped particles was already evaluated for the former process in our previous studies. Moreover, particle shape (as rounded as possible) and flowability are essential as well. Selective laser melting was used for printing samples with different densities and direct energy deposition was used for printing upcycled feedstocks. Powder analyses were loose and tap densities measurements accompanied by a flow test. Characterizations of bulk materials involved density measurements, microstructural observations (using optical and scanning electron microscopy) and mechanical properties such as hardness and tensile tests. This study has been supported by New Space Portugal PR192303 and LAETA-DOI: 10.54499/UIDB/50022/2020.

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