IAF MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Virtual Presentations - IAF MATERIALS AND STRUCTURES SYMPOSIUM (VP)

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3D PRINTED COPPER – GRAPHENE OXIDE COMPOSITES

Abstract

The development of specific metal matrix composites is a valuable approach to design and fabricate components for several industrial applications, space sector included. The latter field is generally demanding as, e.g., lightweight and high-strength materials are often required. Most metals and metallic alloys do not always comply with those requirements, the final outcome being also dependent on the fabrication technologies. In this regard, additive manufacturing (AM) can be a possible alternative to quite easily collect ad hoc composites of complex geometry with tailored functional properties. For this aim, selective laser melting (SLM), a common AM technique based on the melting of selected regions of metallic powder according to a CAD input, was here considered as a potential technique to fabricate 3D printed copper-graphene oxide composites. Copper is particularly interesting for industry, but a substantial lack of investigation in the AM field can be underlined, mainly due to its physicochemical properties, the same that make it attractive for practical applications. The high thermal conductivity and the surface tension forces, may easily induce instabilities during the process which tend to contract in spheroidal sections and prevent the uniform powder spreading of successive layers. Moreover, the molten area experiences rapid heat dissipation and high local thermal gradients, thus leading to possible delamination, layer curling, and part failure. Finally, the resulting porosity degree is a typical issue related to bed powder 3D printing techniques that still needs to be addressed. The potential of graphene oxide (GO) as a filler for SLM specimens has not been widely assessed as well and this should be considered to both introduce a synergistic effect in the final composite and to tailor the processing variables. Graphene is a two-dimensional carbon structure with extraordinary physical and mechanical properties. The high strength and elastic modulus, electron mobility, and thermal conductivity allow to select graphene as a suitable composite filler. Moreover, GO further adds valuable properties that support an effective dispersion within the matrix during the composite preparation stage. Traditional methods generally implemented to produce

this kind of materials can suffer from many limitations, especially referring to carbon nanomaterials, and alternative methods should be evaluated to produce graphene-based reinforced copper composites with specific design. 3D printed Cu-GO samples were therefore assessed to be fully characterized and to critically correlate the collected findings to porosity, being one of the key-issue for AM components.