In-situ Metal Matrix Composites Development for Additive Manufacturing: A Perspective

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Abstract

This paper presents an overview on some ceramic materials capable of achieving in-situ reinforcements in Al/Al-alloy metal matrix composites (MMCs) during laser processing. It also presents perspective on further exploitation of the in-situ reinforcement capabilities for high quality MMCs feedstock material development. The approach utilized in writing this paper encompasses the review of relevant literature on additive manufacturing (AM) of MMCs. It is widely accepted that the in-situ reinforcement approach has proven to be more advantageous than the ex-situ approach. Though there are still some challenges like the formation of detrimental phases and the evaporation of low melting temperature elements, the in-situ reinforcement approach can be used to tailor design composite powder feedstock materials for the AM of MMCs. The preprocessing or tailor-designing in-situ metal matrix composite powder before laser melting into desired components holds more promises for metal additive manufacturing. The need for the development of MMCs powder feedstock that can be directly fabricated using suitable AM technique without prior powder processing like blending or mechanical alloying has not yet been addressed Therefore, having a pre-processed in-situ reinforced MMC feedstock powder can encourage easy fabrication of MMC and other advantages of AM technologies powder recycling. The idea explained in this article is relevant to materials development for AM processing of metal matrix composite. This paper has pointed out future trends for MMCs materials feedstock powder development and new ideas for further exploitation of MMCs and AM technologies. The advantages of tailor-designing composite powders other than merely mixing them has been emphasized.