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Recycling of machining waste by laser metal deposition

Khalid Mahmood
University of Sciences and Technology, Pakistan

Metals are used extensively in production and have wide applications. Extraction and processing of mineral resources consume a huge amount of energy and steel being the most widely used metal is responsible for the single largest share of the energy consumption all over the world. In manufacturing, machining is a metal subtractive process and produces a large quantity of chips/swarf. Efficient recycling of machining waste can save a lot of energy as well as its effective disposal. This necessitates developing an efficient way to take the chips and recombine them into a block or useful shape for further applications. The processing method should not involve remelting in furnace as this has low efficiency and creates problems related to ambient pollution. Laser direct metal deposition (LDMD) is an additive manufacturing technique which uses material efficiently. In LDMD, injected metal powder is laser melted and fused to the substrate and subsequent layers. Quick solidification is achieved by the local heating and by traversing the substrate. However, the high cost of raw metal powder is one of the barriers to use of this technique on a wide scale. A possible solution to the problems of machining waste recycling and high cost of LDMD powder is to consider machining swarf as an alternative build material for LDMD. This paper illustrates the viability of laser metal deposition of carbon steel machining swarf with nonstandard particle size and shape. Particles of unprecedented size and shape have been deposited and the feasibility of using this kind of build material has been established following analysis of different outcome parameters including clad geometry, microstructure and other physical properties. The results suggest that this recycling technique could with further development reduce demand for raw material and the energy required to extract and refine it.

Biography

Khalid Mahmood has done his PhD in Mechanical Engineering from The University of Manchester, UK. His main research area is laser metal deposition. The work is novel in the sense as the machining swarf has been investigated extensively as an alternative feed material in laser cladding of protective coatings as well as to build 3D structures. This is an attempt to address optimal utilization of enormous material waste in machining. On the other hand it tackles to obviate the huge cost of raw metal powder used in laser metal deposition. The findings of the work with recycled material are quite encouraging and are comparable with the conventional raw metal powder.

khalid.mahmood@ceme.nust.edu.pk

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