Anti-wear properties of direct metal laser sintered steel parts and the effect of printing direction

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ABSTRACT

The aim of this research work was to study the effect of building direction on the anti-wear properties of maraging steel parts produced by direct metal laser sintering (DMLS) and how these properties correlate with the obtained mechanical properties. Investigation was performed on EOS M 280 direct metal laser sintering system, which included vertical, horizontal and 45° build-up of different test specimens made from MS1 maraging steel powder (W.No. 1.2709). After additive manufacturing specimens were subjected to aging and then wear and mechanical properties evaluated in different building directions. Mechanical properties included tensile strength, impact and fracture toughness, while wear resistance was evaluated under dry reciprocating sliding conditions. Finally, properties were correlated to the building direction and corresponding microstructure, with the results showing strong influence of the building direction on the obtained anti-wear properties.

INTRODUCTION

In contrast to conventional, subtractive manufacturing methods, additive manufacturing (AM) is based on an incremental layer-by-layer manufacturing [1-3]. As such, most relevant AM technologies commonly use powder or wire as a feedstock which is selectively melted by a focused heat source and consolidated in subsequent cooling to form a part without the need for intermediate shaping tools [4-6]. It is a free form fabrication method, which in recent years has also been successfully applied to the manufacturing of geometrically complex commercial metal components. Especially laser based melting methods such as Selective Laser Melting (SLM) or Direct Metal Laser Sintering (DMLS) have gain great interest allowing the use of different alloys and steel powders [7].

Laser based melting processes produce parts or components from digital information piece-by-piece or layer-by-layer with the overall geometry being determined by laser paths, projection patterns or a combination of the two [5,8,9]. This simultaneously defines the final geometry of the component. Furthermore, during the process, successive layers of metal powder particles are molten and consolidated