

Innovative manufacturing technology of components of machine from amorphous materials

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Abstract:

The presented invention is a technology of manufacturing amorphous elements with the use of selective laser melting (SLM). Iron-based bulk metallic glasses (BMGs) are a promising group of materials, which is not widely used due to problems with obtaining the necessary cooling rates in case of complex structures. The proposed technology is characterized by a small liquid metal pool ($<100\ \mu\text{m}$) and thus allows to achieve a cooling speed of 104-106, which is much higher than those needed for amorphization. At the same time, the incremental character of process allows to obtain elements of almost any shape and size. However, the problem is the large thermal gradients, which in combination with the brittleness of most metallic glasses result in cracks or even delamination in the manufactured elements. In addition, there is heating of already manufactured layers by subsequent layers. Therefore, in order to obtain satisfactory results it was necessary to optimize such factors as: input material, thickness of sintered layer, laser speed and power, distance between individual exposures of the beam or scanning speed (laser beam movement). These parameters directly influence the energy density that is delivered to the sintered powder layer and which determines the structure, mechanical properties and quality of the surface.

Key words:

Additive manufacturing, selective laser melting, amorphous material, glass forming ability, powder