Unique breakthrough in bulk metallic glass manufacturing

Researchers from Sportstech Additive Manufacturing Group at Mid Sweden University have verified the patented technology of the Swedish company Exmet AB by succeeding in making the world first sample of iron based bulk metallic glass (BMG, also amorphous metal or glassy alloy) using electron beam manufacturing technology. This may be a breakthrough in the manufacturing of BMG components.

All initial studies on the sample conducted at Mid Sweden University (including the resilience and microscopy examination) support the claims that this first sample has indeed an amorphous structure, i.e. a structure that differs from a regular crystalline structure. Further thorough studies are under way and the results will be soon reported in a scientific publication.

This shiny tile attached to the solid stainless plate is unique in few aspects. Firstly, metallic glasses (also amorphous metals, BMG or glassy alloys) on their own have unique properties. They are extremely strong (2-15 times than crystalline counterparts), extremely elastic (golf clubs with a face made of BMG) and are often non-corrosive. Amorphous metals have also shown promising resistance against metal fatigue.

ARCAM, electron beam melting (EBM®), a member of the wide family of additive manufacturing technologies, makes it possible to manufacture components of extremely complex shapes within a single process.

– In many cases, additive manufacturing is both faster and less expensive than other, more mature manufacturing methods. In some cases it can yield components that are simply not possible to manufacture using other technologies. And the tile is made of the modern, iron-based BMG, which is relatively inexpensive, lighter than common steel and does not contain environmentally hazardous rare earth metals, says Mikael Bäckström.

Worldwide research of BMGs is driven by the promises of their unique properties. Many application areas, from engineering to biomedical implant manufacturing, can potentially be revolutionized by using advantages of BMGs.

Until now, the manufacturing of even small BMG components has been quite complex and very expensive. Making large BMG components using traditional manufacturing methods, like melt spinning, casting, powder metallurgy or thermoplastic forming, is not possible.

–In all cases when hot bulk components cool down slowly, the atoms have enough time to re-arrange into a regular crystalline structure. Only processes with an extremely quick cooling period, when the atoms “freeze” from the disordered liquid state very quickly, result

in BMG formations. This is why until now, we have only been able to manufacture small or rather thin BMG components, says Mikael Bäckström.

The success of the present research makes a new opening promising to revolutionize the manufacturing of the products and components made from such unique materials as BMG. Preliminary results have already shown that the weight of commercial products can be reduced by 90 % if the technology is exploited. Application areas in need of strong non-corrosive elastic materials are likely to be the main winners of applying the BMGs.

The originator of the worldwide patent for beam based additive manufacturing of amorphous metals is owned by the Swedish company Exmet AB. This ensures the commercial success for the verified technology and future licensees.

Recently, researchers from Sportstech at Mid Sweden University won the award for the most innovative use of EBM technology at an international user conference arranged by ARCAM. It was awarded by, and in competition with, internationally renowned material researchers and advanced users. The award also indicates the commercial value of this technology and the worldwide patent.

- There is great interest in our patented technology on an international basis. We are negotiating with some of the world´s largest companies about applying the technology to different fields, such as aerospace, automotive, electronics and medical devices. The cooperation with Mid Sweden University has worked out very well and we look forward to continuing this work. Simultaneously, we work on powder technology and on verifying Exmet´s technology for laser methods. Altogether, these are exciting times for all of us. The future prospects of Swedish technology, research and export revenue within this field are bright, says Mattias Unosson, CEO of Exmet AB.

The research was carried out in cooperation with the companies Exmet AB, ARCAM AB and Öhlins Racing AB. The funding partners leading to the successful results were the Swedish Agency for Economic and Regional Growth (Tillväxtverket) and the Swedish Governmental Agency for Innovation Systems (Vinnova).

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