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Investigation of design potentials for welding PBF-LB/M manufactured pure copper busbars to conventional copper conductors

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The advantages of the PBF-LB/M process, such as geometric complexity due to increased design freedom or function integration, offer great potential for optimizing products in the automotive sector. However, it often does not go beyond prototyping and small series, as productivity is too low for the required quantities and economies of scale can rarely be exploited lucratively. In the field of e-mobility, hairpin technology has dominated the copper winding of traction drives in recent years. The research field of additive manufacturing of copper windings for e-machines has made significant progress in recent years, but additive manufacturing has not yet prevailed over conventional technologies, despite the product advantages.
In this study the approach of transferring the complexity of conventional hairpin windings into additively manufactured busbar assemblies and then joining them to conventional windings using laser welding is therefore researched. The advantage is that the less complex components of an electric machine can still be manufactured conventionally with high productivity.
For this purpose, different design variants of the connection geometry are developed at the interconnection area of the busbars and manufactured from copper using PBF-LB/M. The manufactured design variants are then joined to the conventional copper conductors using a laser welding process. A comprehensive analysis and evaluation of the connections is then carried out in four main categories. For this purpose, the design, the electrical conductivity, the critical heating and the weldability are examined. Three designs with promising results and requirement fulfilling properties were identified. The results show that functions like form fitting can directly be added to the AM parts and by the complexity transfer, both advantages of additive manufacturing and conventional manufacturing can be combined by means of laser welding.

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