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P4.161 Fabrication of thin-walled fusion blanket components like flow channel inserts by selective laser manufacturing

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The development of new manufacturing methods for the production of key components for nuclear fusion reactors by selective laser manufacturing (SLM) is currently under investigation at Karlsruhe Institute of Technology. SLM offers great potential compared with conventional manufacturing methods, especially for fabrication of thin- and double-walled structures like sandwich-type flow channel inserts (FCIs) or components with complex internal geometries. Material qualification tests with samples produced by SLM Eurofer (identical chemical composition) have shown almost similar material behavior than conventionally fabricated components. Feasibility studies to demonstrate the producibility of sub-components for fusion reactors with complex shapes and structures by SLM technique are ongoing. In conjunction with these feasibility studies, complex 3D structures such as a thin- and double-walled FCI for dual-coolant lead lithium (DCLL) blankets with the 3D shape similar to blanket contours have been successfully manufactured and tested on a preliminary level. Due to limitation in maximum dimensions of components produced with present-day SLM machines, only a model-sized prototype of a sandwich-type FCI had been manufactured. For that reason, the present concept for full-scale applications relies on a modular arrangement assembled from several segments with ceramic connector parts. To overcome space limitations new approaches for bigger respectively longer parts are currently under development. The paper focuses on the principal feasibility of SLM technique to fabricate thin-walled FCIs. The complexity of the fabrication process is outlined and application of SLM technique for production of other fusion blanket sub-components like thin-walled cooling plates with internal cooling channels is addressed.

Presenter: KOEHLY, Christina (IKET Karlsruhe Institute of Technology (KIT))

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