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Large-Scale Synthesis of the Ti_3AlC_2 MAX Phase by Pressureless FAST/SPS Supported by Thermal Modeling

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Layered ternary carbides and nitrides, known as MAX phases, have attracted considerable attention due to their unique combination of ceramic and metallic properties. Among available fabrication methods, FAST/SPS sintering is a cost-effective and time-efficient approach that enables effective control of phase composition through rapid heating and cooling cycles. However, scaling up the FAST/SPS process, particularly under pressureless tool conditions, remains challenging due to thermal inhomogeneity and phase instability. This study reports on the large-scale synthesis of the Ti_3AlC_2 MAX phase under pressureless FAST/SPS conditions, supported by a coupled thermal modelling strategy. The influence of process parameters and tool design on temperature distribution was systematically analyzed to optimize thermal uniformity and phase stability. The modelling results were experimentally validated, enabling the successful synthesis of an 800 g batch of Ti_3AlC_2 with a homogeneous phase composition in a single FAST/SPS cycle. The proposed approach demonstrates a scalable and robust pathway for large-batch MAX phase production, providing a framework for further industrial implementation of pressureless FAST/SPS processing routes.

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Interest in submitting a paper in a special issue of

No interest

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No

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