

Digital twin for thermal management in spark plasma sintering

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The transition of SPS from research to industry faces several challenges. Upsizing leads to temperature inhomogeneity within the sintered part. Another challenge is the enormous power required for heating. The proposed digital twin addresses these issues by optimizing the SPS tooling. The digital twin was validated by sintering 3YSZ samples at 1350 °C and then heating them to 800 °C. The die used had an internal diameter of 50 mm. In the first case (1350 °C), the K-type thermocouple measured the temperature at the external surface of the graphite felt insulation. In the second case (800 °C), the thermocouple measured the die wall temperature. Comparison of the measured temperatures with the digital twin predictions shows good agreement. The digital twin application is highly efficient. Optimizing the SPS tooling reduced the temperature difference between the edge and the center of a 50 mm 3YSZ disc from 88 °C to only 3 °C during the dwell at 1350 °C. At the same time, the power decreased 2.5-fold, and the total sintering energy was half that with non-optimized tooling. The effect of optimization increases with sample diameter. For example, optimizing the tooling for sintering 100 mm 3YSZ discs reduced the temperature difference between the edge and the center during the 1350 °C dwell from 302 °C to 12 °C. The accompanying power reduction was threefold. The total sintering energy was half that required with the non-optimized tooling.

Professional Status of the Speaker

Senior Scientist

Interest in submitting a paper in a special issue of

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Invitation letter for visa

No

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