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Thermo-optical Modelling of Laser Matter Interactions in Selective Laser Melting Processes.[1] RAJ VINNAKOTA, DENTCHO GENOV, Louisiana Tech Univ — Selective laser melting (SLM) is one of the promising advanced manufacturing techniques, which is providing an ideal platform to manufacture components with zero geometric constraints. Coupling the electromagnetic and thermodynamic processes involved in the SLM, and developing the comprehensive theoretical model of the same is of great importance since it can provide significant improvements in the printing processes by revealing the optimal parametric space related to applied laser power, scan velocity, powder material, layer thickness and porosity. Here, we present a self-consistent Thermo-optical model which simultaneously solves the Maxwell's and the heat transfer equations and provides an insight into the electromagnetic energy released in the powder-beds and the concurrent thermodynamics of the particles temperature rise and onset of melting. The numerical calculations are compared with developed analytical model of the SLM process providing insight into the dynamics between laser facilitated Joule heating and radiation mitigated rise in temperature. These results provide guidelines toward improved energy efficiency and optimization of the SLM process scan rates.

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