

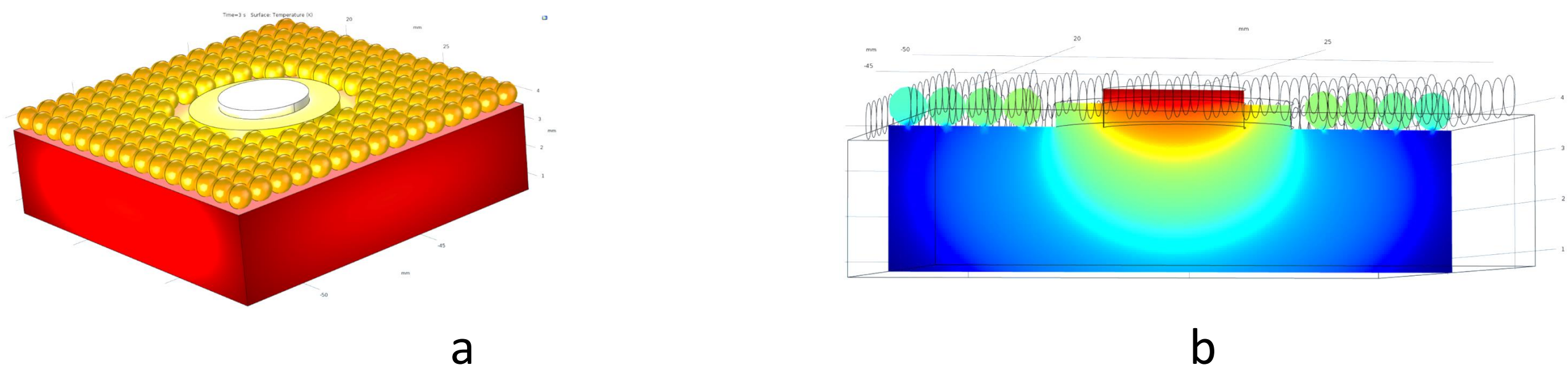
# Simulation of Dynamic Thermal Field Assisting DMLS Additive Manufacturing of Biocompatible Ti-Alloy

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**Introduction:** Dynamic thermal field assisting a wider area of the powder bed fused with laser during DMLS metal powder printing aims to modify the heat flow distribution within the 3D printing process and during successive printed layers consolidation, with effects upon post-processing paths



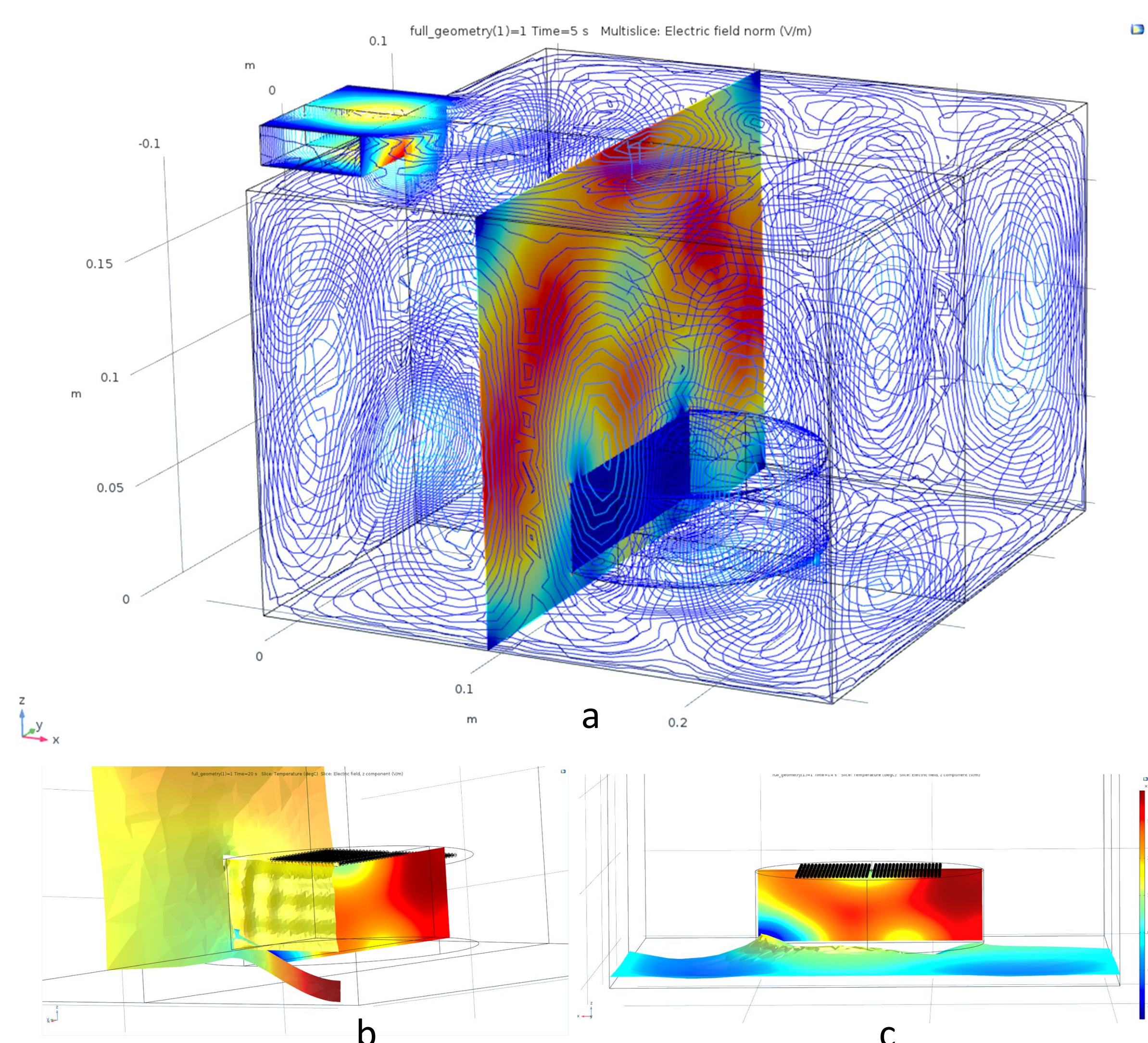
**Figure 1.** Laser fused powder bed (DMLS)

a. Ti6Al4V powder volume model b. Thermal effect during DMLS [1]

## Computational Methods:

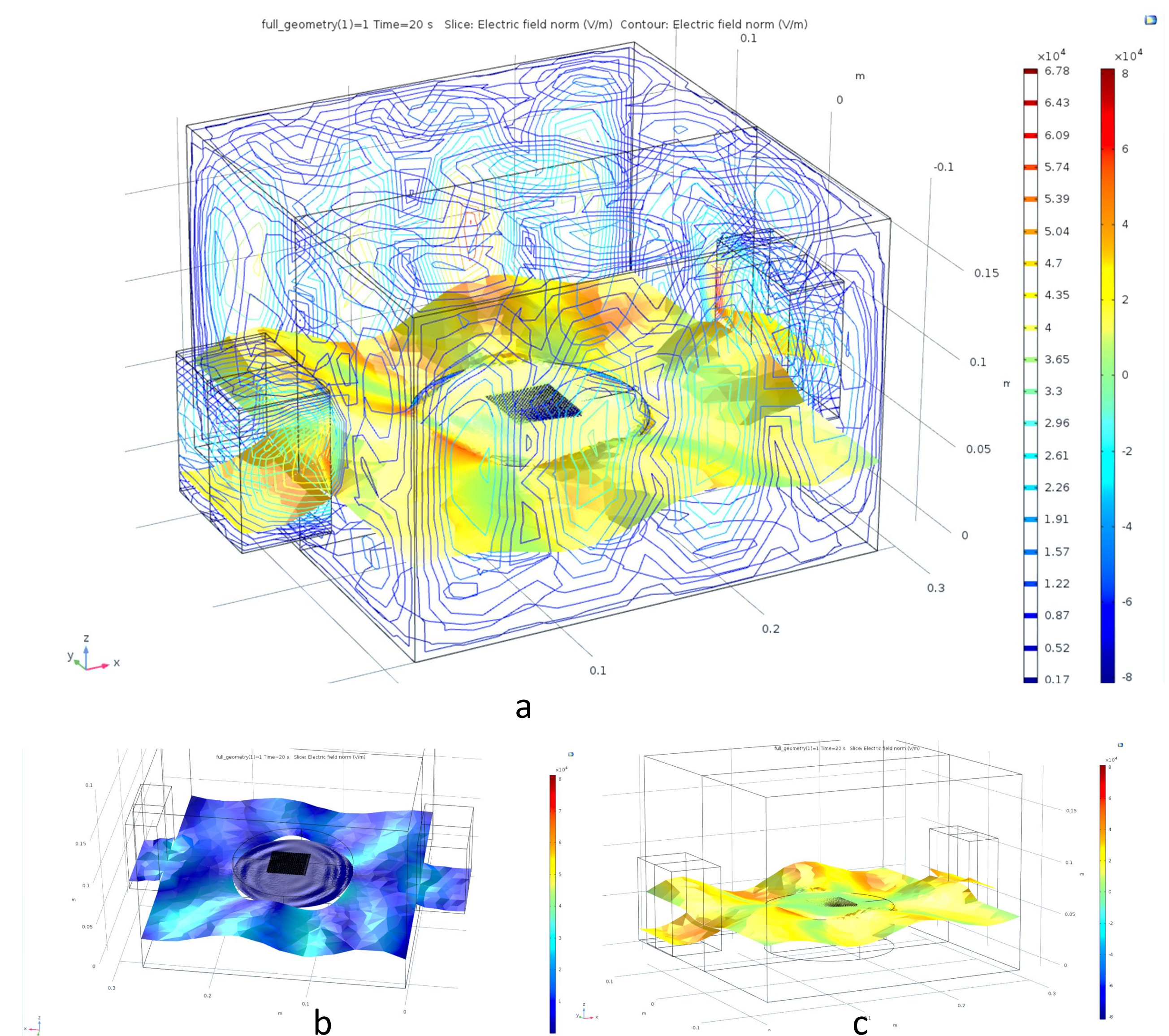
COMSOL Multiphysics® was used to analyze and describe in depth the thermal field distribution into Ti-6Al-4V ELI spheroids powder bed, during the laser sintering, and the successive layer addition and heating for usual DMLS (fig.1) and microwave stimulated DMLS (fig.2-4)

**Results:** Within the powder bed a new path of heat transfer was designed. Laser fused powder bed geometry was generated in COMSOL Multiphysics® (fig.2-4) or was created on SolidWorks® and exported through LiveLink™ for SolidWorks® add-on in COMSOL Multiphysics® (fig.1)



**Figure 2.** DMLS in one radiation source microwave oven

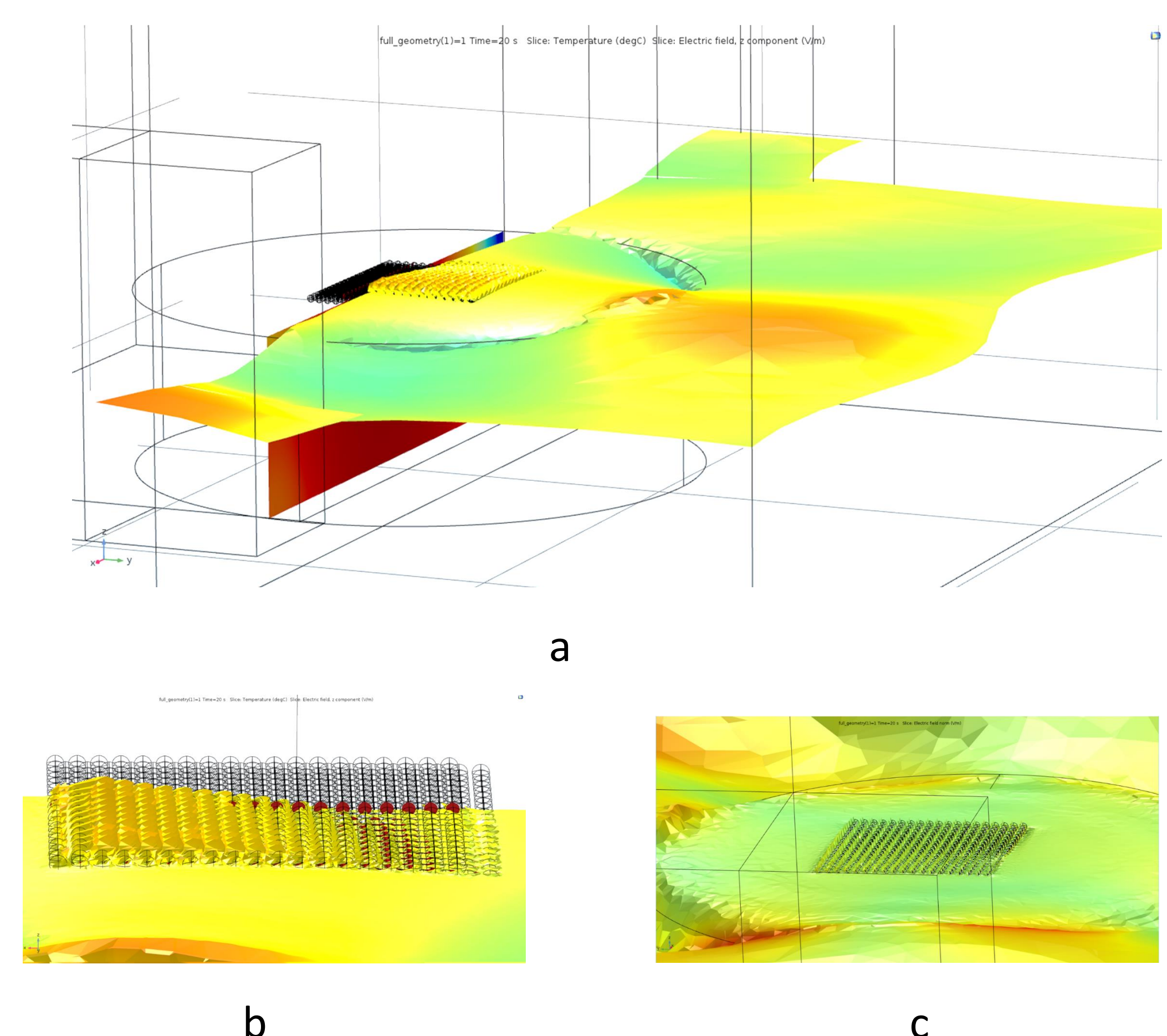
(a, b, c) Electromagnetic waves acting during DMLS



**Figure 3.** DMLS of Ti-powder in two radiation sources microwave oven

(a, b, c) Electromagnetic waves acting during DMLS

**Conclusions:** In order to simulate the accurate processing conditions, COMSOL Multiphysics® material dBs were used and customized with a new material (Ti-6Al-4V ELI, Grade 23). During microwave assisted DMLS thermal field effects dynamic superposition generate better conditions for Ti powder melting, fusing and consolidation (fig.4 a,b,c).



**Figure 4.** Local and transitory (a,b,c) effects of microwave assisted DMLS

## References:

1. E. Lacatus, M.A.Sopronyi, G.C. Alecu, A. Tudor, Analysis of 3D Biocompatible Additive Structures Using COMSOL Multiphysics®, Excerpt from the Proceedings of the 2014 COMSOL Conference in Cambridge, (2014)