Microstructural Exploration of Additive Manufacturing Materials Through Simulation

Enrique Escobar de Obaldia*, Javed Akram† and Brent Stucker†

*ANSYS Germany GmbH
Staudenfeldweg 20, 83624 Otterfing, Germany

† ANSYS, Inc
1794 Olympic Parkway, Suite 110
Park City, UT 84098

ABSTRACT

In the development of Additive Manufacturing components, one of the main challenges is the qualification and certification of parts. In order to achieve outstanding mechanical properties and structurally sound components, a process parameter selection prior to manufacturing must be carried. Obtaining the optimal manufacturing parameters requires extensive use of expensive and time-consuming experimental techniques (e.g. EBSD and optimal microscopy). To assure that the parts will fulfil the expected requirements, the microstructural analysis must consider the differences in printing strategies, machine configuration and multiple phase transformation.

This presentation will discuss the ANSYS Additive Science tool, which can be used to understand the microstructural evolution (grain orientation, size) for user-defined conditions. A Cellular automata-based microstructure model is implemented to simulate the microstructure evolution in materials processed through metal based additive manufacturing process such as Selective Laser Melting (SLM), Electron Beam Melting (EBM), and Direct Energy Deposition (DED). The Cellular Automata method is an algorithm which describes the spatial and temporal evolution of a physical system by applying deterministic or probabilistic transformation rules [1]. Effect of different scan patterns and other process parameters on evolving morphology and orientation of a grain will be demonstrated and discussed along with side by side comparison with experimental results. The results obtained from this tool can be used to predict the mechanical properties of a materials such as yield strengths and elongations using crystal plasticity model or analytical Hall-Petch relationship [2].

REFERENCES

[1] J. Akram, P. Chalavadi, D. Pal, and B. Stucker, "Understanding grain evolution in additive manufacturing through modeling," Addit. Manuf., vol. 21, 2018.

[2] Smith, William F.; Hashemi, Javad (2006), Foundations of Materials Science and Engineering(4th ed.), McGraw-Hill, ISBN 978-0-07-295358-9.