PhD in Material Science and Technology

Research Title: Development of the Electron Beam Melting process for the production of new materials

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Context of the research activity	The Electron Beam Melting (EBM) process belongs to the Additive Manufacturing (AM) technologies for the production of metallic components. The main advantages offered by EBM with respect to other AM processes are two. First, EBM works in a high vacuum environment, which makes the process particularly suitable in the manufacturing of reactive metals such as Titanium. Second, the electron beam heating offers the potential to preheat the metal powders up to 1100 °C due to its high scanning rate. This attribute is crucial for the fabrication of brittle metallic materials such as TiAl intermetallic alloys because it highly reduces the thermal shock and prevents cracks or micro cracks formation during solidification. With the above advantages, EBM has become one of the fastest growing AM techniques in recent years, and a wide variety of metallic materials have been processed and evaluated (Nickel superalloys, titanium alloys, gamma TiAl intermetallics alloys, refractory metals like Nb, copper alloys etc). Here at Politecnico of Torino an ARCAM A2x machine is available and we want to exploit it for the optimization of the process parameters for new materials.

Objectives	The aim of the work is the optimization of the Electron Beam Melting for the processing of new materials. Several parameters are involved such as power of the electron bean, rate of the electron beam, temperature of preheating, scanning strategy etc… and an in deep understanding of them if necessary in order to minimize the residual defects in the produced parts such as pores and microcracks. Furthermore, the above mentioned process parameter highly impact on the resulting phase composition and microstructure of the produced parts. Also this point must be investigated and understood and coupled with the optimization of subsequent heat treatments in order to increase the mechanical

	properties for the application. Optical microscope, SEM-FESEM coupled EDS, X-ray diffraction, microhardness, hardness, tensile tests, thermal analysis, will be among the main characterizations.

Skills and competencies for the development of the activity	Skills and competencies in the preparation and characterization of metallic materials as well as correlation of microstructures and mechanical properties of metallic materials. Knowledge about the additive manufacturing process for the production of metallic materials.