Metal additive manufacturing for sustainable energy applications

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Additive manufacturing technologies present high potentialities in many sectors: aerospace, biomedical, automotive and energy. The realization of complex geometries, the reduction of waste material and of assembly phases are some of the innovative aspects of these technologies. One of the main hindrances in widespread diffusion of these technologies is the lack of materials suitable for different processes. In the case of specific applications, stringent technological demands limit the range of materials available.Considering energy applications, additive manufacturing can be used to realize components with improved geometries and in single part, which do not require assembly, as in the case of heat exchangers and of turbines. In this work two case studies are reported: a ferritic alloy for applications in corrosive alkaline environments, as ammonia solutions, designed for the realization by AM of heat exchangers for absorptionmachines with ammonia-water cycle; the use of Electron Beam Melting, EBM, process for the realization of micro-turbines for Organic Rankine Cycle, ORC. Absorption machines can be coupled with renewable energy sources for air-conditioning applications and they require many heat exchangers working with ammonia. For this reason, a ferritic alloy has been developed and produced in bulk and powder form, by VIM and EIGA processes respectively, for heat exchangers production by Laser Powder Bed Fusion processes (LPBF). In the second case, sustainable energy production can be achieved by micro-ORC, < 100 kWel, which can use renewable systems to obtain a heat source, with turbines realized by AM. Advantages and critical aspects regarding these production techniques will be discussed.