ABSTRACT NANOINNOVATION 2023

Alloy design for Additive Manufacturing for applications in the energy sector: a case study

D. Mirabile Gattia

Over the last decade, additive technologies have attracted great interest due to the possibility of realizing components with complex geometries and in a single or in few pieces to be assembled. Heat exchange is one of the energy sectors in which additive technologies can express all their potentialities by the realization of components with internal channels. In parallel with the increase of available additive technologies and processes, the development of new materials has become necessary. In particular, for specific applications, technical requirements limit the number of useful materials. In these cases alloy design allows to define properly compositions of suitable materials. This approach is used also in the case of materials for additive manufacturing. In this work the design of a ferritic alloy the production of heat exchangers for application in corrosive environments will be discussed. This is the case of heat exchangers in absorption machines, with ammonia-water cycle, which can be coupled with renewable energy sources for air-conditioning applications. In these machines heat exchangers are critical components. The activity allowed to obtain a ferritic alloy with higher thermal conductivity, lower coefficient of thermal expansion respect to AISI316 and good resistance to harsh alkaline ammonia-water solutions. The alloy has been produced in the form of bulk and of gas atomized powder for 3D printing, by VIM and EIGA processes respectively, and samples have been produced by Laser Powder Bed Fusion (LPBF). In order to optimize the alloy, further microstructural investigations are needed, also to ascertain composition and crystal structure of fine precipitates. The final objective of the activity will be to realize the heat exchangers for absorption machines by additive manufacturing and using the ferritic alloy. This research was supported by MASE-ENEA bilateral program agreement "Research on Electric System" – Project 1.4 "Materiali di frontiera per usi energetici - Frontier materials for energy uses" (ADP MiSE-ENEA Piano Triennale di Realizzazione 2022-2024)