Materials for AM in the Program Agreement with the Italian Ministry of Economic Development: project 1.3 "Advanced Materials for Energy"

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In this talk the progresses of the Project 1.3 "Advanced Materials for Energy" will be presented. The project, lasting three years, is structured in four Work Packages. Two WPs, 1 and 2, are focused on the synthesis of new thermo- and pyroelectric materials and on the realization of devices for applications in energy harvesting. The other two WPs, 3 and 4, linked to MAIA, are focused on the realization of materials for additive manufacturing and on the realization of small prototypes. Three research centers, Casaccia, Portici and Brindisi and the Laboratory of Faenza of ENEA are involved in the project activities.

The project is focused on different aspects of Additive Manufacturing, mainly considering the possibility of integrating or substituting traditional manufacturing process, i.e. subtractive and foundry ones, for the realization of components for energy applications. The project is focused on advanced materials, being one of the main challenging aspects in these processes. Interesting technologies, as Atomic Diffusion Additive Manufacturing (ADAM) or Bound Metal Deposition (BMD), allow to realize metallic components starting from composite material, generally polymeric with metal or ceramic charges. The process is completely different respect to metal 3D printing processes, as powder bed or direct metal deposition. In the project the development of metal composites for these additive manufacturing processes will be under study, considering both the two aspects related to binders and charges. Moreover a plasma atomization machine, designed in ENEA, will be used to realize powders, even with customized composition, for AM processes, as charges for composites and slurries and for powder bed or direct deposition. The project will consider also the realization of composites with functionalized nanoparticles, even in the form of core-shell particles, to be used for improving their properties. In solar cooling and heating systems based on ammonia-water cycles, severe environment conditions could be present which heavily stress the materials. Nickel and copper are highly affected by ammonia corrosion. For this reason a new ferrous ODS alloy, with suitable thermal properties, is under study to be used for the realization of heat exchangers by additive manufacturing processes. One of the aims of the project, starting from previous activities, is in fact the realization by 3D printing of an heat exchanger for its use in absorption machines. The realization of heat exchangers in polymeric composite materials with micro and nano charges, will be considered also for less severe conditions and for the optimization of the heat exchanger design. Another activity in the project will be the optimization of suitable slurries, to be used in LDM processes for realizing, a ceramic component for energy production processes based on biomasses. Considering the impact of failures in energetic processes, as the case of turbines for energy production or light weight components, the aspects related to quality, as presence of defects in as built 3D printed metallic components, will be studied with different approaches: microstructural analysis, non-destructive and mechanical tests, tribological and wear tests. Furthermore the optimization of laser-based 3D printing processes and the realization of improved heat pipes, for heat dissipation, and Pelton impellers, for mini and micro hydro, by additive manufacturing will be studied within the project.