

Insights from tribology for advanced manufacturing

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Current multi-scale manufacturing research has opened new opportunities and challenges to carry unprecedented functionalities of new products on different scales indispensable to the construction of safe, energy-saving and functional designs. They are of interest for wide applications, for example, rapid casting, micro-machining and micro-joining of multi-layered materials and structures, additive manufacturing, and many others. It is, however, difficult to achieve a scalable and robust technology for manufacturing with controlled designed functionalities that lead to the solution "product manufacturability" in industrial conditions. It requires taking into account upstream (design phase), from the functional needs, the overall quality in terms of:

- Material processing by assessing its multi-scale structural qualities related to its state as induced by the manufacturing operation;
- Product manufacturability by quantifying the impact of processing conditions on its functional requirements and service life (especially in the case of severely stressed products in extreme engineering).

If functional requirements can be established and well understood in terms of specification quality of the product after developing the appropriate manufacturing technologies, this does not apply to multi-scale structural characterization and mechanical properties of the product in service. Characteristics are being identified at the stage of product development. The objective of this keynote paper is to show how insights from tribology can be used to control tribo-functional surface design based on the premise that an intimate connection exists between the physical mechanisms prevailing during manufacturing and the multi-scale induced-modification on the produced surfaces. The implementation of this multiscale approach within a mass production environment allows to correlate the tribo-functional performance of the intolerance designed surface and the manufacturing process of its generation.