Editorial corner – a personal view

Additive manufacturing of plastic and polymer composite parts: Promises and challenges of 3D-printing

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Factories of the future are expected to implement new integrated design-manufacturing approaches to go towards ‘advanced manufacturing’. Additive manufacturing (AM, or 3D-printing) actually offers new opportunities to the plastics processing industry to meet this challenge when developing applications for high-tech industrial (aerospace, medical/dental, automotive) and consumer (home, fashion and entertainment goods) markets. According to ASTM F42 Committee, AM processes can be categorized into seven areas by the type of materials used, the deposition technique, and the way the material is fused or solidified: powder bed fusion, vat photopolymerization, material extrusion, material jetting, binder jetting, sheet lamination and directed (or focused) energy deposition. Materials and processes are interconnected. As far as plastics and polymer composites are concerned, the most popular 3D-printing processes are selective laser sintering, stereolithography, fused deposition modeling, and material jetting.

The ever-growing success of 3D-printing is due to its advantages over conventional manufacturing, e.g. virtually unlimited design freedom, ability to produce parts without moulds, high degree of complexity achievable even in fine details, ability to get local texturing or functionally-graded structures when using multi-materials. However, AM is mostly employed up to now for prototypes, models for form, fit and function, and non-load bearing parts; still too rarely for the fabrication of engineering parts and final

products. The reason is that the remaining issues to be addressed are still numerous. It is desirable to:

- extend the range of suitable amorphous and semi-crystalline polymers and filled/reinforced compounds, including shape-memory and liquid-crystal polymers,
- reduce the materials cost by feeding 3D-printers directly with pellets (i.e. avoid intermediate forms or semi-products such as powders or wires),
- master induced residual stresses and resulting shrinkage/warpage issues to warrant dimensional stability and accuracy over time,
- improve surface finish of parts,
- develop process modeling and simulation, topological optimization, and mechanical performance prediction to enable full virtual engineering chain,
- increase process control and monitoring, and on-line quality control (in-situ sensors for early detection of flaws),
- increase build-up rates,

... the success key being of course the development of high-value applications.

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