Editorial corner – a personal view

Powder injection molding: Borderlines and interfaces

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In addition to traditional thermoplastics injection molding technology (which also produces novelties continuously) there is a special branch exhibiting double digit growth both in developing and in mature markets: powder injection molding. In a broad sense this is a family of technologies by itself, the essence of which is that first a highly filled compound is prepared with metal or ceramic filler, which is injection molded (or compression molded) to a ‘green product’. This step is followed by the decomposition of the organic component and by sintering, resulting in a final product. The technology by itself is not new but, due to the almost infinite combination of parameters and components it continuously opens up new possibilities. Here I provide only a non-exhaustive list of possibilities being presently explored. First to mention is the possibility of controlled porosity formation: depending on the selection of the polymer and the inorganic component the resulting final product may be porous or non-porous. Residual porosity depends on the volatility and on the decomposition rate of the polymer and on the conditions of sintering. The degradation and evaporation rate of the organic component may be controlled by forming pores in the green body before the sintering processes e.g. by selective dissolution at the surface using solvents or supercritical fluids. The pores may be filled by ceramic precursor polymers which are transformed into amorphous or nano-crystalline solids on thermal decomposition. A special subgroup of the technologies mentioned is called gel casting, wherein *in situ* formed organic-inorganic hybrids are prepared, molded and decomposed in a

controlled manner into a mostly inorganic final product. (It is not necessary, however, to remove the organic components completely, thermoset organic-inorganic hybrids may also be the final products). It is possible to combine various metallic and/or ceramic components with each other or with polymers, to prepare composites with special electric, optical or magnetic properties. Nano-scale milling of the ceramic or metal components is important, which may include mechanical activation, formation of non-equilibrium (high entropy) phases. If the fine-grained structure is to be preserved the sintering process should be led to stabilize the special non-equilibrium structures (by preventing recrystallization) in the final product. These problems are further aggravated by the fact that typical shrinking in the sintering process may be as high-as 20–30% which means further challenges to the technologists aiming at high dimensional precision. I foresee further possibilities in developing new products and technologies in this exciting field of science and technology, where we are at the borderline of scientific disciplines and where controlled manipulation of interfaces is the key to success.

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