ADVANCED MATERIALS SCIENCE

Fields of Expertise TU Graz

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Source: Lunghammer – TU Graz

Smart production of smart materials is a hot topic in the FoE Advanced Materials Science as well as at the Smart Production Graz research center. Many activities are being pursued in materials science, physics, and chemistry.

Powder-based additive manufacturing, e.g. by laser powder bed fusion or plasma direct metal deposition, of functional materials, such as magnetic materials, high-entropy alloys or shape-memory alloys is one example of ongoing research. The process can be advanced for building smart parts, e.g. integrating temperature, pressure, and humidity sensors, realizing porous structures for NH_3 and biofuel synthesis and joining metallic and fiber reinforced polymers in-situ and ex-situ. However, also wire-based additive manufacturing by electron beam, plasma, and arc, as well as hybrid methods are applied for different tasks.

Another example is the technology of biobased systems, dealing with the development of conjugates based on biomolecules of living organism origin and analogues. This implements the manufacturing, analysis and application of organic structures and inorganic/organic hybrid systems. The focus here is set on the development of biomaterials with emphasis on surface specific processes (surface functionalization) and manufacturing of 3D structured materials and using modern technology as 3D printing or laser lithography, development of bio-inks formulations, cross linking – and self-assembly structures, for example tissue engineering.

A third research area is in in-situ atomic force microscopy enabled by an emerging 3D nano-printing technology. The research program is centered around Focused Electron Beam Induced Deposition which is an increasingly relevant direct-write technology for flexible, bottom-up synthesis of high-resolution nanostructures, applicable on virtually any substrate material and morphology. The research activities are focused on two main aspects, i.e. controlled 3D nanofabrication and defined material properties.

More and more important is the consideration of increasing the efficiency of processes (e.g. by reducing scrap), the reduction of critical raw materials (e.g. rare earth elements), the realization of lightweight structures (e.g. by topology optimization) and taking into account usage of circular materials (e.g. by using recycled materials). Machine learning methods are a means that are used to meet those targets.

Source: Lunghammer – TU Graz

Rupert Kargl

The Potential of Polysaccharides in Biomaterial Science

Natural polymers form the basis of life and understanding and modifying their properties can lead to new applications. From hyaluronic acid in connective tissue to cellulose in plants and peptidoglycans in bacteria, polysaccharides are one of the most important structural components of living things.

The use of naturally occurring or chemically modified polysaccharides in material science, or in contact with living tissue is therefore our main research interest at the Institute of Biobased Systems (institute head Karin Stana Kleinschek). This requires a highly interdisciplinary expertise, which we are trying to create together with collaborators within and outside TU Graz. >