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The Role of Chemistry in Direct Ink Writing of Multifunctional Materials, Structures and Devices

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There is currently a burgeoning interest in 3D printing multifunctional materials, structures and devices for a multitude of applications such as energy, health and space. Direct ink writing (DIW) is a versatile 3D printing method based on room temperature extrusion of shear thinning fluids (aka inks) on digitally predefined substrate locations to deposit complex geometries on a layer-by-layer fashion. In this talk we will discuss the critical role that chemistry plays in DIW . In particular we will be discussing model examples to discuss how precursor chemistry influences ink formulation, printing and post-printing treatments. For example, during ink formulation chemistry plays a crucial role since it influences the fluid's viscosity and flow properties as well as its curing characteristics. Chemical bonding and surface interactions are also of great importance for realizing stable printing and printed layer adhesion. In many systems, inks undergo chemical reactions after printing (e.g., polymerization and gelation) to transition from a liquid state to a solid structure. In addition, during multimaterial printing (e.g., coaxial DIW) chemistry enables the combination and smooth extrusion of different ink materials in a single step. Finally, the development of ecofriendly inks is another area that we will be discussing in terms of green chemistry approaches to reduce harmful solvents and energy consumption.

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