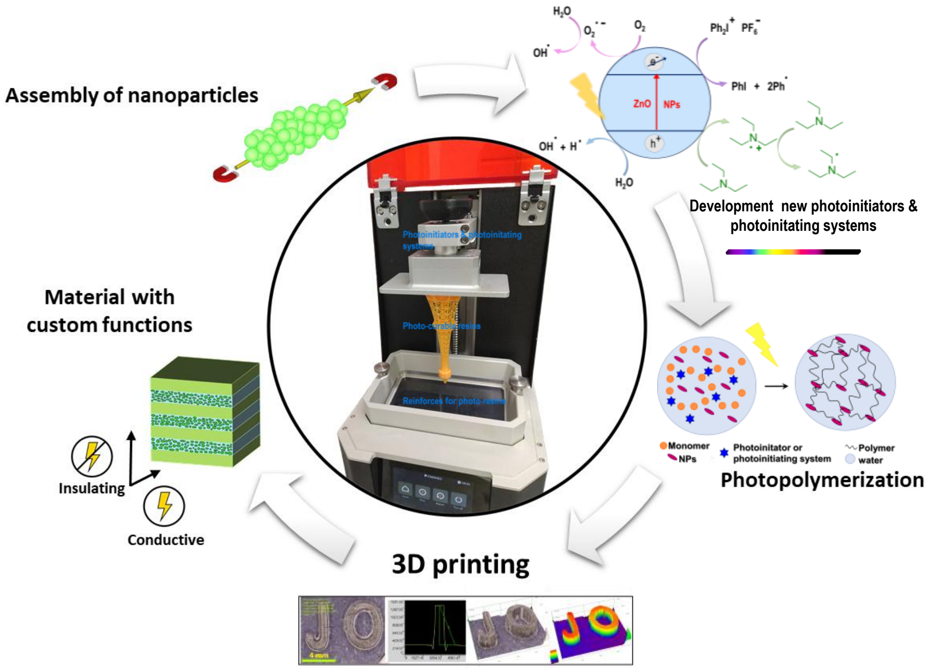
The project ***"Advanced photopolymerized nanocomposite materials processed by additive manufacturing"*** *f*ocuses on the development of innovative nanomaterials which could be processed by 3D-VAT printing. The progress of human society was always tightly bound to implementation of new technologies, which were often driven by the new inventions in material processing. It is no coincidence that the most ancient eras of our history are titled after their most advanced materials as the *stone age*, *bronze age*, and *iron age*. In the same manner, the present is sometimes referred to as the *plastic age*. Plastics have an advantage over the more traditional materials such as metals, glass, or ceramics in the relative simplicity and cost-efficiency of their processing, lightweight properties, and versatility. Raw material is usually fabricated and distributed in form of pellets while its properties are customized individually for each application by additives before shaping it into the final object. Additive manufacturing technologies such as 3D printing has recently brought the versatility to a new level by precisely adding small pieces of materials to the pre-defined positions. The current portfolio of 3D printing covers a wide range of techniques and materials including metals and ceramics, but these are far less spread than the simpler 3D printing of plastics. Nowadays, manufacturers are competing to improve the quality of the printouts by increasing the resolution of their printers, which is generally given by the size of a voxel, the smallest volume which could be added by the printer. However, if the voxel contains nanoparticles, its inner structure could be further tuned and offer an additional level of versatility. For illustration, electrically conductive nanoparticles arranged in a specific manner can form conductive paths across the voxel and make it conductive only in certain directions while piezoelectric nanoparticles can develop electrical charge upon mechanic deformation which could be turned into a sensor or an energy harvester. Even though these innovative materials based on nanoparticles embedded in polymer matrix, termed as nanocomposites,have been thoroughly investigated by scientists for several decades, they only slowly find their way towards industrial-scale applications. One of the reasons is the requirement on the superb control of the nanoparticle assembly into the desired shapes while distinct parts of a single object could favor different structures. Combined with 3D-printing, this issue could be split into individual voxels and solved selectively regarding the demand of the application. Assembly of nanoparticles relies on the interplay of forces facilitated by sufficient mobility of species in the dispersing medium, a condition best fulfilled by 3D printing of photopolymerizable resins. However, the chemical reaction taking place during the photopolymerization can interfere with the delicate balance of forces and, contrary, the nanoparticles can alter the reaction mechanism. Besides, certain nanoparticles scatter, absorb, or shield the UV light used to cure the photopolymer resins which increase the demands on the photo-initiating efficiency.




This project answers the current challenge for highly customizable functional materials for next-generation applications by addressing the design of novel high-efficient photoinitiators and photoinitiating systems, assembly of nanoparticles upon photopolymerization reaction and their mutual interference with the reaction mechanism, and the strategies for fabrication of functional photopolymerized 3D printed nanocomposites with high-precision structural control from the nano- to macroscale.