Integration of the “nano-function” into products is still limited due to drawbacks of gas phase and chemical synthesis methods regarding particle aggregation and contamination by adsorbates causing deactivation of the building blocks’ surface. In addition, thermodynamically-controlled synthesis methods naturally face limited access to alloy nanoparticle systems with miscibility gaps.

As an alternative synthesis route, nanoparticle generation by pulsed laser ablation in liquids has proven its capability to generate ligand-free colloidal nanoparticles with high purity for a variety of materials. Good reproducibility and significant up-scaling of nanoparticle generation were achieved recently by a continuous flow synthesis using a high-power ultrafast laser system leading to productivities of up to 4 g/h colloidal nanoparticles. The transferability of this synthesis route to a variety of materials and liquids further enabled high-throughput screening of molar fraction series of e.g. water oxidation catalysts. Alloy nanoparticles series (i.e., AgAu, NiMo, AuFe, AgNi, FeNi) were synthesized and their phase structure as well as their application potential will be discussed. Interestingly, on the one hand, phase diagram seems to play a role in ruling the nanoparticles crystal structure and phase segregation, but at the same time, unusual structures difficult to access by conventional synthesis methods are yielded, indicating kinetic control.

In this talk, laser synthesis of colloids will be introduced at the example of metal and alloy nanoparticles, including the resulting material properties. Application of these laser-generated nanoparticles by supporting them on carrier structures for heterogeneous catalysis, or in biomedicine will be demonstrated.