Controlling the structure of binary protein crystals used for the assembly of inorganic nanoparticle superlattices

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We have recently introduced a method for the construction of multifunctional biohybrid material, using protein containers, engineered with opposite surface charge[1], as atomically precise ligand shells for the assembly of inorganic nanoparticles into highly ordered superlattices[2]. The engineered protein containers form crystalline assemblies, which were characterized with single crystal X-ray crystallography to high resolution. Importantly, using the same building blocks, the composition of the crystals (unitary or binary) and the lattice parameters can be tuned simply by adjusting the crystallization conditions. For example, the coordination number of each protein container in the binary structure can be modified from eight to twelve. The cavity of the protein container can be filled with metal oxide nanoparticle, prior to assembly of the protein containers. The crystallization of oppositely charged protein containers with nanoparticle cargo yields highly ordered nanoparticle superlattices as free-standing crystals, with up to a few hundred micrometers in size. Moreover, the protein matrix can be stabilized by fixation of the crystals with glutaraldehyde without changing the original crystal structure. The application potential of these biohybrid materials, e.g. in catalysis, is currently evaluated.

1) T. Beck, S. Tetter, M. Künzle, D. Hilvert, *Angew. Chemie Int. Ed.* **2015**, *54*, 937–940.
2) M. Künzle, T. Eckert, T. Beck, *J. Am. Chem. Soc.* **2016**, *138*, 12731–12734.