***Predicting* ordered equilibrium structures for patchy particles**

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From the basic laws of thermodynamics we know that for given external parameters, such as pressure or temperature, particles will always arrange in ordered equilibrium structures such that the respective thermodynamic potential is minimized with respect to the lattice parameters that define the structure. However, in practice this minimization task turns out to be highly non-trivial and from the numerical point of view very delicate: high dimensional parameter spaces and rugged energy landscapes are the main problems that have to be faced. A few years ago we have proposed an optimization strategy that is based on ideas of genetic algorithms. In this concept, a possible ordered structure is considered to be an individual that is exposed on the computer to some artificial evolution: in this process the individuals have to survive under the condition that their thermodynamic potential is as small as possible. In this way, the individuals 'converge' after a reasonable number of generations towards the equilibrium structure. In subsequent numerous applications to a large variety of soft matter systems we have found that this optimization strategy is highly flexible, reliable, and efficient and that it copes extremely well with the above mentioned problems.

In this contribution we will discuss ordered equilibrium structures formed by so-called patchy particles, i.e., spherically symmetric colloids that are decorated on their surface by mutually repelling and/or attracting regions. Very recently, such particles have attracted the attention of soft matter scientists: experimentalists are now able to locate the patchy regions with high precision on the colloidal surface and to neatly define their spatial extent. With their highly directional potentials, these patchy particles are therefore excellent candidates to form ordered equilibrium structures with a desired symmetry. Our extensive investigations based on the genetic algorithm technique provides some insight into the self-assembly strategy of patchy particles.