Westfälische Wilhelms-Universität Münster

Fachbereich Physik

› Allgemeines Physikalisches Kolloquium

› Donnerstag, 25.01.2018 um 16 Uhr c.t.

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Universität Tübingen

Watching structure formation in real time

Structure formation processes, including crystallization and growth as the most obvious examples, are ubiquitous in nature and technology. Importantly, for their understanding it is not sufficient to study the minimum of the free energy, but non-equilibrium issues need to be considered. This is a challenge for both theory and experiment, in particular for many modern materials, which are rather complex and frequently multi-component forms of condensed matter.

After a general introduction of the basic concepts, we present examples related to in situ and real time scattering experiments on the formation of transient structures, the kinetics of phase transformations, and the stabilization of non-equilibrium structures. We discuss the peculiarities of structure formation in molecular systems, with particular emphasis on the differences to the growth of elemental (atomic), simple crystals or thin films.

We focus on two qualitative differences between atoms and molecular systems.

The first is the existence of internal degrees of freedom, i.e. in particular the orientational degrees of freedom, which can introduce new equilibrium phases (as is obvious in liquid crystals) and also additional complexities in non-equilibrium structure formation, such as orientational transitions during growth and possibly different scaling laws [1,2].

Kolloquiums-Kaffee
ab 16 Uhr vor dem Hörsaal

Wilhelm-Klemm-Straße 10
Institutsgruppe 1 Hörsaal HS 2

The second concerns the typically different distance dependence (i.e., range) of the interaction potentials, which also impact of course the equilibrium phase diagram (with the appearance / disappearance of the liquid phase depending on interaction range as a famous example).

We show that the interaction range has profound impact on the diffusion behavior of adsorbates and thus on the structure formation [3].

Finally, we comment on the general understanding of non-equilibrium states of matter and consequences for structure formation of mixtures of molecular systems including devices based on these [4-6].

Contributions by A. Hinderhofer and A. Gerlach as well as numerous external collaborators are gratefully acknowledged.

[1] A. Dürr et al., PRL 90 (2003) 016104
[2] S. Kowarik et al, PRL 96 (2006) 125504
[3] N. Kleppmann et al., PRE 95 (2017) 020801(R)
[4] R. Banerjee et al., PRL 110 (2013) 185506
[5] A. Aufderheide et al., PRL 109 (2012) 156102
[6] C. Lorch et al., APL 107 (2015) 201903