Report: Phase Field Simulations: Materials Science meets Biology and Medicine

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The workshop "Phase Field Simulations: Materials Science meets Biology and Medicine" which was held at the Max-Planck Institute for the Physics of Complex Systems during Nov 12-14 2008 brought together scientists from different fields who work on various aspects of nonlinear and nonequilibrium pattern formation processes. The common link between the participants from physics, materials science, biological physics and medicine, was the phase field method, which is nowadays probably the most prominent and flexible numerical technique to solve problems with moving boundaries. This motivation of the workshop, to exchange ideas from very different scientific fields was very fruitful, since the common background on a mainly computational method bridged the gap between the participants and allowed to get new insights into very different questions at the frontier of current research.

Both the oral and poster presentations covered a wide range of applications of phase field methods. A strong focus was on the classical aspect of solidification processes, which was originally the foundation of the phase field method. Here, also the influence of fluid flow on dendritic growth, elastic effects on solid-solid transformations as well as complex polycrystalline solidification processes, which are highly important for many technological applications, were discussed. Other presentations were dedicated to crack front instabilities under combined tensile and shear loading and heterogeneous nucleation processes. An emphasis was on a more recent development, the phase field crystal method, which incorporates also atomistic effects, and which is related to the classical density functional theory of freezing.

A strong accent during the workshop was on soft matter physics, ranging from phase field descriptions of liquid crystals to viscous fingering and

pinch-off singularities during Hele-Shaw flow. New insights on the dynamics of vesicles under shear flow shed light on the dynamics of e.g. red blood cells. Concerning applications of the phase field method in medicine and biology, new ideas towards and understanding and modeling of the growth and angiogenesis of tumors were presented. The development of suitable approaches from fundamental processes like the spreading of blood vessels was carefully elucidated.

The strength of the meeting was to bring together scientists from very different fields, and to stimulate valuable discussions between them. Intense discussions suggest the formation of European networks to further link the activities of the groups, and steps towards such an integration were undertaken during the meeting. The success of this workshop reflects the importance of the prospering phase field method and its fast evolution, and a perpetual repetition of such meetings is a strong desire for the future.