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EDITOR'S DESK

The third issue of this year "*Phase-Field Methods for Pattern-Formation*" is co-edited by three guests Abhik Choudhury, Materials Engg, Indian Institute of Science, Saswata Bhattacharyya, IIT-Hyderabad and Rajdip Mukherjee, IIT-Kanpur.

Understanding of evolution of pattern formation in microstructures under variable conditions of physico- chemical parameters is often a challenge in materials science and phase field methods offer a diligent and unified approach to solve such problems. The emphasis of the reviews presented in this issue concentrate on solution to problems of micro-structural evolution during solidification, solid-state phase transformations and electrochemical applications.

Frigyes Podmaniczky, Gyula I. Tóth, Tamás Pusztai and László Gránásy focus their review on the understanding of nucleation phenomenon using both conventional phase-field techniques and molecular scale phase-field approaches. The review by Mathis Plapp discusses numerical simulation of solidification microstructures. M.P. Gururajan and Arka Lahiri in their review address the study of the formation and evolution of microstructures. Solidification of multi-component alloys is of high technical and scientific importance and this issue is detailed by Johannes Hötzer, Michael Kellner, Philipp Steinmetz and Britta Nestler in the next article. Simulating electrochemical phenomena such as etching, electro-deposition, electromigration, intercalation based on phase field modelling is highlighted by Saswata Bhattacharyya, Soumya Bandyopadhyayy and Abhik Choudhury.

I am particularly elated to bring out this issue involving one of our young faculty, Abhik Choudhury who along with his two colleagues has put up an outstanding effort in bringing out this excellent treatise on Phase filed methods.

As always enormous efforts by our technical team led by Mrs. Kavitha Harish has kept the high standard of quality in getting the articles into their final form.

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GUEST EDITOR'S DESK

Phase-Field Methods for Pattern-Formation

Phase-field modeling is fast evolving into a powerful method for solutions to problems involving complicated inter-facial evolution. Such problems routinely arise in materials science with regards to the evolution of micro-structures under varied conditions of temperature, composition, deformation, electrochemical, magnetic and electric histories. This structural evolution is typically between the nano- to the micrometer scale. Among the methods available for the solution to these problems of micro-structural evolution, the phase-field method derives its appeal owing to the ease of being generalizable to all dimensions while utilizing relatively simpler computational discretizations and algorithms than that required by contemporary sharp-interface methods. This also makes it possible for employing relatively less complex parallelization schemes and thereby allow for exploration of bigger statistically representative ensembles of micro-structural evolution. Over the past three decades, the methods have matured into becoming quantitative simulations tools which can be utilized not only for the comparison with experiments and analytical theories, but also for predicting micro-structure evolution under varied processing conditions and thus truly becoming a tool which can aid in the micro-structural design both in terms of alloy chemistries and processing conditions.

In this particular issue we highlight aspects of the phase-field method with regards to its usage for solution to problems of micro-structural evolution during solidification, solid-state phase transformations and electrochemical applications. Our emphasis in this issue has been to give a brief overview of the state-of-the art of the phase-field models in each of the above fields by inviting experts to present reviews of the applications of the phase-field in each of the topics. Particularly, we have addressed applications of the phase-field models for simulating nucleation, a brief history of the development of the phase-field models of solidification along with their applications and usage of phase-field models for studying instabilities in solid-state phase transformations.

We would like to thank T.N. Guru Row (Chief Editor) and the editorial committee of the journal for providing us this opportunity as guest editors for this issue. We are grateful to all the authors for formulating such excellent reviews as well as bearing with us on the time-schedules. Special thanks to Mrs. Kavitha Harish and her team for compilation of the articles. Finally, thanks to the reviewers, copy editors and proof readers for helping us complete this issue in time.

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