Preface to Special Topic

Published in:
Journal of Applied Physics

DOI:
10.1063/1.4948578

Published: 14/05/2016

Please cite the original version:
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Citation: Journal of Applied Physics 119, 181301 (2016); doi: 10.1063/1.4948578
View online: http://dx.doi.org/10.1063/1.4948578
View Table of Contents: http://aip.scitation.org/toc/jap/119/18
Published by the American Institute of Physics

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Preface to Special Topic: Defects in Semiconductors

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(Received 8 April 2016; accepted 19 April 2016; published online 5 May 2016)

[http://dx.doi.org/10.1063/1.4948578]

The 28th International Conference on Defects in Semiconductors (ICDS-2015) was held in Espoo, Finland, July 27–31, 2015. The conferences in this series, which dates back to 1959, are held every 2 years and provide a valuable forum where researchers studying the fundamentals of defects in semiconductors can share their most recent findings with colleagues and thereby advance understanding in this technologically and scientifically important field. Extended abstracts were electronically distributed to participants as proceedings of the conference. This Special Topic Section provides a snapshot of the field through the Invited Tutorial (by Professor Audrius Alkauskas, Professor Matthew D. McCluskey, and Professor Chris G. Van de Walle) and original contributions from plenary and invited speakers.

The elemental semiconductors Si and Ge continue to provide the scientific community with unexplored defect-related phenomena. This is evident in the reports on iron-related defects in Si and on the origin of carrier density limitations in heavily n-type doped Ge. While III-V arsenides and, in particular, the EL2 defects were at focus in the 1990s with optically active defects in III-V nitrides following thanks to advances in blue laser diodes and light emitting diodes, oxides have now emerged as a versatile collection of semiconductors with a wide variety of defect-related issues to be resolved. Examples in this Special Topic Section include investigations on defects in ZnO, CdO, and on the surface of TiO$_2$. These oxide semiconductors typically combine transparency with high electrical carrier concentrations and hence conductivity. However, hydrogen and both metal and oxygen vacancy defects appear to play important roles in determining the properties of these materials. Achieving p-type conductivity is a challenge in many of these wide band gap semiconductors, and significant attention is given to hole localization either at distinct defects or at polaronic states. The search for efficient solar absorbers made of earth-abundant elements generates novel semiconductor compounds at an increasing pace; the report on bipolar self-doping of Cu$_3$N is a representative example of this quest.

III-V nitride semiconductors are at focus in the development of solid-state lighting technologies. Identification of defects in devices is an outstanding challenge, as often the conditions for the synthesis of the thin films in the device structures are such that free-standing material where defect detection is routine does not have comparable qualities. Defect engineering and utilizing not only the charge localization properties of defects but also spin-related phenomena are strongly emerging. Single defects in diamond and silicon carbide and their spin states are heavily investigated in the community. It should be noted that many current topics of interest are not included in this Special Topic Section, such as organic semiconductors, defects in nanostructures, or extended defects. Novel approaches and techniques for defect studies in semiconductors keep emerging such as atom probe tomography on the experimental side. Theoretical modelling is becoming more and more accurate. Efficient combination of experiment and theory, the topic of the Invited Tutorial and the focus theme of ICDS-2015, provides new understanding of the defect physics.

The success of the conference that gathered 300 scientists could not have been possible without the financial support provided by Aalto University School of Science, the Helsinki Region Transport (HSL), City of Espoo, Agilent Technologies and Nokia. We thank these institutions for their help in putting this conference together, and making it again possible to select two young scientists as winners of the Corbett Prize: Thomas Auzelle (Université Grenoble Alpes/CEA Grenoble, France) and Jan Eric Stehr (Linköping University, Sweden). Finally, we thank the members of the program committee who played a key role in selecting presenters, as well as the authors of the scientific papers in this Special Topic Section. We also thank the speakers and poster participants who made the conference so interesting and enjoyable for all. We hope to see a similarly enthusiastic crowd of scientists in Japan, at ICDS-2017.

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