D1.5 – Special journal issue addressing PCM heterostructures

BeforeHand – 824957

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Horizon 2020 work programme within the Objective ICT-07-2018: Electronic Smart Systems (ESS)

Summary

1 Introduction

The present document is the fifth Deliverable generated by the WP1 "Management" and it is focused on the realization of Special journal issue.

2 Special Issue

Stefania M. S. Privitera from CNR-IMM working within the consortium BeforeHand is guest editor of a special issue of ***Nanomaterials*** (ISSN 2079-4991). This special issue belongs to the section "**Nanocomposite Materials**" and it is entitled:

"Synthesis, Properties and Applications of Ge chalcogenides" https://www.mdpi.com/journal/nanomaterials/special_issues/Ge_chalcogenides .

The special issue covers advances in synthesis techniques, including nanostructures and superlattices, in the understanding of the material properties, and in devices for optical, electronic and thermoelectric applications. The Nanomaterials journal is full Open Access, with an impact factor of **5.076**.

Stefania Privitera handled to get within the special issue a special session for BeforeHand contributions.

3 Special Issue Guest Editor

Dr. Stefania M. S. Privitera

Institute for Microelectronics and Microsystems (IMM), National Research Council (CNR), Catania, Italy

Interests: design, integration and electrical characterization of electronic devices; structural and electrical characterization of materials for advanced data storage, resistive switching memories and phase change materials; solid state phase transitions, induced by laser, electric pulses or ion beam irradiation; development of catalysts for solar fuels.

4 Special Issue Information

Germanium (Ge) chalcogenides are characterized by unique properties which make these materials interesting for a very wide range of applications, from phase change memories to radio frequency (RF) switches and ovonic threshold switches, from photonics to thermoelectric and photovoltaic devices.

By employing electric or laser pulses, Ge chalcogenide materials undergo a large change of the electrical and/or optical properties, enabling their use as storage media, as in phase change optical and electronic memories, or as fast selectors. In many cases the physical properties can be finely tuned by changing the Ge amount, which plays a key role in determining the applications, performance and reliability of the devices.

Ge chalcogenides are also characterized by low lattice thermal conductivity and high point defect concentration, making them also promising candidates for lead-free thermoelectric applications.

This special issue will cover advances in Ge chalcogenides synthesis techniques, including nanostructures and superlattices, in the understanding of the unique properties of Ge chalcogenides, and in devices for optical, electronic and thermoelectric applications.

5 Keywords

- germanium
- phase change materials
- chalcogenide glasses
- Ge chalcogenide nanostructures and superlattices
- ovonic threshold switch
- phase change memories
- RF switches
- thermoelectrics
- chalcogenide metamaterials

6 BeforeHand contributions

The topics addressed by the BeforeHand project suit very well with those covered by the journal Nanomaterials, and in particular with the special issue ”Synthesis, Properties and Applications of Ge chalcogenides”. Several partners have contributed to this special issue, obtaining a wide and open access dissemination of some of the scientific results achieved within the project.

The contribution from the BeforeHand partners to the special issue are listed in the following:

1. “Phase Change Ge-Rich Ge–Sb–Te/Sb2Te3 Core-Shell Nanowires by Metal Organic Chemical Vapor Deposition”
   by Arun Kumar, Raimondo Cecchini, Claudia Wiemer, Valentina Mussi, Sara De Simone, Raffaella Calarco, Mario Scuderi, Giuseppe Nicotra and Massimo Longo
   Nanomaterials 2021, 11(12), 3358; https://doi.org/10.3390/nano11123358

2. “High-Throughput Calculations on the Decomposition Reactions of Off-Stoichiometry GeSbTe Alloys for Embedded Memories”
   by Omar Abou El Kheir and Marco Bernasconi
   Nanomaterials 2021, 11(9), 2382; https://doi.org/10.3390/nano11092382

3. “Crystallization and Electrical Properties of Ge-Rich GeSbTe Alloys”
   by Stefano Cecchi, Iñaki Lopez Garcia, Antonio M. Mio, Eugenio Zallo, Omar Abou El Kheir, Raffaella Calarco, Marco Bernasconi, Giuseppe Nicotra and Stefania M. S. Privitera
   Nanomaterials 2022, 12(4), 631; https://doi.org/10.3390/nano12040631

4. “Interface Formation during the Growth of Phase Change Material Heterostructures Based on Ge-Rich Ge-Sb-Te Alloys”
   by Caroline Chèze, Flavia Righi Riva, Giulia Di Bella, Ernesto Placidi, Simone Prili, Marco Bertelli, Adriano Diaz Fattorini, Massimo Longo, Raffaella Calarco, Marco Bernasconi, Omar Abou El Kheir and Fabrizio Arciprete
   Nanomaterials 2022, 12(6), 1007; https://doi.org/10.3390/nano12061007

5. “Growth, Electronic and Electrical Characterization of Ge-Rich Ge–Sb–Te Alloy”
   by Adriano Díaz Fattorini, Caroline Chèze, Iñaki López García, Christian Petrucci, Marco Bertelli, Flavia Righi Riva, Simone Prili, Stefania M. S. Privitera, Marzia Buscema, Antonella Sciuto, Salvatore Di Franco, Giuseppe D’Arrigo, Massimo Longo, Sara De Simone, Valentina Mussi, Ernesto Placidi, Marie-Claire Cyrille, Nguyet-Phuong Tran, Raffaella Calarco and Fabrizio Arciprete
   Nanomaterials 2022, 12(8), 1340; https://doi.org/10.3390/nano12081340

6. “Interface analysis of MOCVD grown GeTe/Sb2Te3 and Ge-rich Ge-Sb-Te/Sb2Te3 core-shell Nanowires”
   by Seyed Ariana Mirshokraee, Arun Kumar, Massimo Longo, Matteo Cantoni, Alessio Lamperti, Claudia Wiemer
   Nanomaterials 2022, 12(10), 1623; https://doi.org/10.3390/nano12101623

7. Phase Separation in Ge-Rich GeSbTe at Different Length Scales: Melt-Quenched Bulk versus Annealed Thin Films
   Daniel Tadesse Yimam, A. J. T. Van Der Ree, Omar Abou El Kheir, Jamo Momand, Majid Ahmadi, George Palasantzas, Marco Bernasconi and Bart J. Kooi
   Nanomaterials 2022, 12(10), 1717; https://doi.org/10.3390/nano12101717

8. "Structural and electric properties of annealed $Ge_2Sb_2Te_5$ films grown on a flexible polyimide substrate"
by Marco Bertelli, Adriano Diaz Fattorini, Sara De Simone, Sabrina Calvi, Riccardo Plebani, Valentina Mussi, Fabrizio Arciprete, Raffaella Calarco, and Massimo Longo
Nanomaterials 2022, 12(12), 2001; https://doi.org/10.3390/nano12122001