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Editorial

Special Issue of the 1st International Conference on Nanofluids (ICNf19)

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Abstract: This editorial note is dedicated to the 1st International Conference on Nanofluids (ICNf19), which was organized under the auspices of Nanouptake COST Action in June 2019, in Castelló (Spain). After a brief report about the conference issues, the successful selected contributions to this Special Issue of *Energies* about the ICNf19 are introduced.

Keywords: nanouptake; nanofluids; properties; energy; applications

1. Introduction

Since the early 1990s, nanofluids have received growing attention due to their strong potential as heat transfer fluids in energy systems. This interest is part of a wider context of efficient and clean energy demand. Nanofluid science is multidisciplinary and far-reaching, as many complex phenomena are involved and thus require knowledge in many scientific fields, leading to cross-practice collaborations.

In this context, four years ago, the Nanouptake CA15119 project [1] was launched by Enrique Julià Bolivar, under the auspices of the European Cooperation in Science and Technology (COST). The main objectives of this scientific project were to create a Europe-wide network of leading R+D+i institutions and of key industries, to reinforce existing collaborations at a European level to develop and foster the use of nanofluids as advanced heat transfer/thermal storage materials to increase the efficiency of heat exchange and storage systems [1].

With this goal, our European consortium is developing a common understanding of nanofluid preparation and characterization, addressing nanofluids' key barriers from the market and creating an open space for new relevant research.

This editorial note gives a short report of the 1st International Conference on Nanofluids and the 2nd European Symposium of Nanofluids (ICNf2019) [2] which we organized; a series of international conferences initiated by our consortium in 2017 with the 1st European Symposium of Nanofluids (ESNf2017) in Lisbon [3–5]. Then, the successful selected contributions to this Special Issue of *Energies* are introduced.

2. ICNf2019: A Short Report

ICNf2019 [2] was held in Castelló (Spain) from 26th to 28th June 2019, after the successful previous experience of the 1st European Symposium of Nanofluids (ESNf2017) two years before in Lisbon [3–5]. The new edition of the conference in 2019 started with the idea of expanding its reach outside Europe, in order to encourage the participation of speakers on an international scale.

The conference became a great opportunity to exchange knowledge among academics, researchers and companies, and also to share the current progress in the field of nanofluids for energy applications.

During the three days of the conference, and due to the number of important participants, three parallel sessions were required to cover the nine different nanofluids thematic sessions, ranging from basic research to real world industrial applications.

This first international edition of the conference has been a great success, both at the quantitative level (the number of communications and participants) and from a qualitative point of view (the scientific level and internationalization). More than 150 contributions have been received and, after a peer-review process from two different members of the Scientific Committee, 126 were accepted; 84 as oral and 42 as poster presentations. More than 200 participants from 45 different countries from five continents attended the conference. Five international keynote speakers from China, Australia, South Africa, Thailand and Germany, respectively, presented their high impact research in the plenary sessions of the congress.

All accepted contributions have been published in open access in the conference proceedings, which are freely available here [6]. Additionally, selected authors were invited to send extended versions of their conference contributions to the *Energies* ICNf2019 Special Issue. After a standard peer-review process, nine papers have been accepted for publication in this Special Issue. Before a short introduction of these papers, we wish to once more thank the people involved in the organization and the scientific committee which made this conference a great event, as well as all the sponsors, exhibitors, collaborators and partners.

3. ICNf2019: About the Selected Papers of the SI

Among the papers submitted to this special issue, nine articles have been published after careful review: seven full research papers and two reviews. Authors' geographical distribution (published papers) is:

- Spain (4);
- Bosnia and Herzegovina (2);
- Portugal (1);
- Slovakia (1);
- France (1)*;
- Turkey (1)*.

* Same submission with two correspondences.

The papers in this special issue cover a broad range of fundamental and applied research aspects on nanofluid science and development, and reflect the current investigations and knowledge in different topics. It should be mentioned that most of these papers also reflect the collaborations between researchers and labs involved in COST Action Nanouptake; some of these research works have been performed during Short-Term Scientific Missions (STSM), which have been one of the most successful aspects of this program.

The first paper, by Cabaleiro et al. [7], reports a comprehensive experimental characterization of phase change material (paraffin-in-water) nano-emulsions. The effect of dispersed phase concentrations of 2, 4 and 10 wt.% on the dynamic viscosity, surface tension and wettability of nano-emulsions is investigated, showing the impact of paraffin droplets and surfactant on these properties.

In [8], Grosu et al. propose two strategies to solve the creeping problem in thermal measuring systems for molten salts and molten salts based nanofluids. This paper shows that the use of crucibles with nanoscale roughness on the inner surface, or made/coated with a low surface energy material, allows the creeping phenomenon to be solved, controlling the wettability of the surfaces, and leads to proper measurement and property evaluation.

Regarding the wettability property of nanofluids, Çobanoğlu et al. [9] study the validity of single-phase contact angle correlations for several nanofluids with different types of nanoparticles

dispersed in water. It is shown that these models can be used for dilute nanofluids at ambient conditions, and the authors also demonstrate that the droplet shapes of nanofluids are well predicted by a model based on force balance.

Rajnak et al. [10] evaluate the thermophysical properties, such as thermal conductivity, dielectric permittivity and viscosity, of magnetic nanofluid containing iron oxide nanoparticles and commercial oil. The influence of nanoparticle content and magnetic field on these properties is studied, showing in particular an anisotropy effect and a potential application of these nanofluids in power transformers.

In the paper from Martínez-Merino et al. [11], nanofluids based on one-dimensional MoS_2, WS_2 nanosheets and thermal oil currently used in concentrating solar plants (CSP) are prepared and characterized. The influence of nanostructure morphologies on nanofluid stability and thermal properties are presented and discussed. It is finally shown that the thermal conductivity of these nanofluids is strongly improved in comparison to thermal oil, leading to potential efficiency in solar collectors.

Two other papers deal with numerical simulations of nanofluid flow and heat transfer properties. In the first one, the laminar flow of ethylene glycol-based silicon nitride (EG-Si_3N_4) nanofluid in a smooth horizontal pipe subjected to forced heat convection with constant wall heat flux is numerically investigated by Berberović and Bikić [12], considering the thermophysical properties measured experimentally and the non-Newtonian features of nanofluids. An increase in heat transfer of the EG-Si_3N_4 nanofluid is reported in comparison to the EG for all the nanoparticle loadings and flow rates, evidencing a potential of these nanofluids for heat transfer applications.

The second article, from Alic [13], analyzes the entransy flow dissipation rate of three serially-connected cylindrical heating elements with Al_20_3 nanofluids as working fluids varying the concentration and flow rate. A model is developed based on a newly introduced dimension irreversibility ratio, defined as the ratio between entransy flow dissipation and thermally generated entropy, to optimize the geometric and process parameters of cylindrical heating elements.

The last two papers give an overview of the thermal and electroactive properties of graphene nanofluids [14], and both practical and theoretical recommendations about the measurement of the thermal conductivity of ionic melts and nanofluids [15], respectively. In [14], the authors focus on the development of graphene and reduced graphene oxide dispersed in aqueous and organic electrolytes, and the evaluation of their thermal and electrochemical properties. These nanofluids are demonstrated to be good candidates for heat transfer and energy storage applications.

Finally, in [15], the available techniques for the measurement of the thermal conductivity of fluids, including nanofluids, ionic liquids and molten salts, are critically analyzed, with special focus on transient methods.

4. Conclusions

This Editorial note was dedicated to the 1st International Conference on Nanofluids and the 2nd European Symposium of Nanofluids (ICNf2019). After a short report about the conference, the successful invited submissions [7–15] to this Special Issue of *Energies* were introduced. We believe that the articles in this special issue, whose main parts were presented during the conference, will contribute significantly to the development of nanofluid science and challenges in heat transfer and energy applications.

We would like to thank all the authors for their contributions in this special issue, and thank the editorial staff for their help during the process, as well as all the reviewers for their efforts in the evaluation of the submitted papers and their critical and meaningful comments. We found the selection and editing of the papers for this special issue to be very inspiring and rewarding.

In addition, this editorial note gives us the opportunity and pleasure to acknowledge all the members of the Core Group and Grant Holder Managers for their strong involvement in the achievement of this joint program. This Special Issue is dedicated to Enrique Julià Bolivar, who initiated this Action; nothing would have been possible without him.

Author Contributions: P.E., L.H.L. and M.H.B.; writing–review and editing. L.H.L. is the Nanouptake COST Action chair and chair of the conference. M.H.B. is a Working Group leader of the Nanouptake COST Action and vice-chair of the conference. P.E. is a member of the scientific committee of the conference, vice-chair of the conference session and the STSM coordinator of the Nanouptake COST Action. All authors have read and agreed to the published version of the manuscript.

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