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Editorial

Special Issue on Advanced Materials and Nanotechnology for Sustainable Energy and Environmental Applications

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1. Introduction

Materials play a very important role in the technological development of a society, greatly impacting people's daily lives. Indeed, the development of innovative materials and the enhancement of existing ones are closely linked to the continuous demand for more advanced and sophisticated applications. Although aspects related to the study, the synthesis and the applications of materials are of interdisciplinary interest, in the last few years, great attention has been paid to the development of advanced materials for environmental preservation and sustainable energy technologies.

This Special Issue aimed to cover the current design, synthesis, and characterization of innovative advanced materials and nanotechnologies, as well as novel applications able to offer promising solutions to the these pressing themes.

2. Sustainable Energy and Environmental Applications

The development of new materials and processes, able to complete the approaching energetic transition challenge, aiming to produce, convert, harvest, transport, and store clean energy [1–3], is strictly related to global environmental issues.

Indeed, the limited reserves of fossil fuels, together with their high environmental impact on greenhouse gas emissions and the growth of the global energy demand, have raised the ambitious goal to produce efficient materials for energy-related fields, able at the same time to respond to sustainable and environmentally friendly principles [4,5]. The possibility to undertake a virtuous circuit that is able to give new life to waste products is also a possibility that well fits these objectives [6,7]. In order to reach these targets, multi-disciplinary expertise is required and encouraged.

In this view, in this Special Issue, novel, advanced and improved materials were fully investigated and applied to improve energy systems, sensing devices and waste valorization for fuel production.

Nardelli et al. [8] employed a promising ionic liquid as an advanced heat transfer fluid in solar thermal energy applications. Thanks to their high heat capacity, low melting point and relatively high density in the typical operating conditions of solar thermal energy systems, ionic liquid can be used in this field, but needs to be opportunely selected. Authors investigated the thermal stability and corrosion effects of these compounds, developing a promising method for their selection with a suitable lifetime able to meet the durability requirements of commercial and industrial solar thermal applications [8].

A composite material based on silicone vapor-permeable foam filled with lithium chloride salt was investigated for low-temperature heat storage applications by Mastronardo et al. [9]. Thermal energy storage is regarded an efficient and effective means to store solar energy when it is available in excess. In this process, heat is transferred to the material that, due to the dehydration reaction, is stored as long as the salt is in the dehydrated form. When heat is required, water is made accessible to the salt, reversible

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hydration takes place and heat is released, making the heat discharge available and controllable on demand. Lithium chloride salt was used for this purpose, but, being known for its deliquescent effect, it was incorporated in a composite matrix, characterized, and tested under hydration/dehydration cycles. The results showed an effective embedding of the material, which limited the salt release when overhydrated, thus making it a competitive candidate in the related application field [9].

A light harvesting system was presented by Elrashidi [10]. Silicon nanowires were coated with a graphene layer and plasmonic nanoparticles were distributed on the top surface of the silicon substrate layer to realize a solar cell. The proposed structure was used for efficient light harvesting in the visible and near-infrared regions. The performance of the solar cell was tested for different nanoparticle materials and dimensions, as well as for different solar cell structures, reporting improved results compared to similar reported systems [10].

Bonaccorsi et al. [11] presented a metal oxide sensor based on zinc oxide for possible use in the monitoring of low concentrations of volatile organic compounds, that are generally released during the phenomenon of food degradation. In particular, the device was able to detect the target volatile, hexanal, with minimum interference from all the others. In this way the material was proved to function as a selective gas sensor, giving an important indication of the quality and conservation of meat [11].

Similarly, Gnisci et al. [12] used a nanostructured material based on tin oxide to develop low cost and real-time resistive sensors useful in the monitoring of the fermentation process and storage of many foods and beverages. In particular, the effect of different working atmospheres was taking into account for the detection of gaseous diacetyl, generally produced during these processes and undesired over a specific threshold. The sensor showed a low detection limit, good selectivity and low response/recovery times [12].

The approach of waste valorisation was pursued instead by Fazzino et al. [13], whose study aimed to address the full valorization of anchovies in order to extract fish oil, an omega-3 source, and to produce biomethane through anaerobic digestion. In addition, the proposed extraction was a green-solvent process [13].

Finally, Satira et al. [14], starting from the hydrothermal carbonization of orange peel waste, presented a simple and green protocol to obtain hydrochar and high-added value products, such as 5-hydroxymethylfurfural, furfural, levulinic acid and alkyl levulinates. Numerous process variables were investigated in order to find the optimum conditions that maximized the yields of products resulting from waste valorisation [14].

3. Concluding Remarks

As proved by the authors, there are many facets of the same issue and many very different ways to contribute to improve clean energy technologies and environmental sustainability. The two aspects are strictly related and, as also shown by the latest trends in the scientific research, these bonded themes will continue to be the focal point in future decades.

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References

1. Bonaccorsi, L.; Fotia, A.; Malara, A.; Frontera, P. Advanced adsorbent materials for waste energy recovery. *Energies* **2020**, *13*, 4299. [CrossRef]
2. Frontera, P.; Kumita, M.; Malara, A.; Nishizawa, J.; Bonaccorsi, L. Manufacturing and assessment of electrospun PVP/TEOS microfibres for adsorptive heat transformers. *Coatings* **2019**, *9*, 443. [CrossRef]
3. Frontera, P.; Macario, A.; Malara, A.; Santangelo, S.; Triolo, C.; Crea, F.; Antonucci, P. Trimetallic Ni-based catalysts over gadolinia-doped ceria for green fuel production. *Catalysts* **2018**, *8*, 435. [CrossRef]
4. Frontera, P.; Malara, A.; Modafferi, V.; Antonucci, V.; Antonucci, P.; Macario, A. Catalytic activity of Ni-Co supported metals in carbon dioxides methanation. *Can. J. Chem. Eng.* **2020**, *98*, 1924–1934. [CrossRef]
5. Malara, A.; Frontera, P.; Antonucci, P.; Macario, A. Smart recycling of carbon oxides: Current status of methanation reaction. *Curr. Opin. Green Sustain. Chem.* **2020**, *26*, 100376. [CrossRef]
6. Malara, A.; Paone, E.; Frontera, P.; Bonaccorsi, L.; Panzera, G.; Mauriello, F. Sustainable exploitation of coffee silverskin in water remediation. *Sustainability* **2018**, *10*, 3547. [CrossRef]
7. Miceli, M.; Frontera, P.; Macario, A.; Malara, A. Recovery/reuse of heterogeneous supported spent catalysts. *Catalysts* **2021**, *11*, 591. [CrossRef]
8. Nardelli, F.; Bramanti, E.; Lavacchi, A.; Pizzanelli, S.; Campanella, B.; Forte, C.; Berretti, E.; Freni, A. Thermal Stability of Ionic Liquids: Effect of Metals. *Appl. Sci.* **2022**, *12*, 1652. [CrossRef]
9. Mastronardo, E.; Piperopoulos, E.; Palamara, D.; Frazzica, A.; Calabrese, L. Morphological Observation of LiCl Deliquescence in PDMS-Based Composite Foams. *Appl. Sci.* **2022**, *12*, 1510. [CrossRef]
10. Elrashidi, A. Light Harvesting in Silicon Nanowires Solar Cells by Using Graphene Layer and Plasmonic Nanoparticles. *Appl. Sci.* **2022**, *12*, 2519. [CrossRef]
11. Bonaccorsi, L.; Donato, A.; Fotia, A.; Frontera, P.; Gnisci, A. Competitive Detection of Volatile Compounds from Food Degradation by a Zinc Oxide Sensor. *Appl. Sci.* **2022**, *12*, 2261. [CrossRef]
12. Gnisci, A.; Fotia, A.; Bonaccorsi, L.; Donato, A. Effect of Working Atmospheres on the Detection of Diacetyl by Resistive SnO_2 Sensor. *Appl. Sci.* **2022**, *12*, 367. [CrossRef]
13. Fazzino, F.; Paone, E.; Pedullà, A.; Mauriello, F.; Calabrò, P.S. A New Biorefinery Approach for the Full Valorisation of Anchovy Residues: Use of the Sludge Generated during the Extraction of Fish Oil as a Nitrogen Supplement in Anaerobic Digestion. *Appl. Sci.* **2021**, *11*, 10163. [CrossRef]
14. Satira, A.; Paone, E.; Bressi, V.; Iannazzo, D.; Marra, F.; Calabrò, P.S.; Mauriello, F.; Espro, C. Hydrothermal Carbonization as Sustainable Process for the Complete Upgrading of Orange Peel Waste into Value-Added Chemicals and Bio-Carbon Materials. *Appl. Sci.* **2021**, *11*, 10983. [CrossRef]