In the last century, polymers have dominated the materials market, and in the later part of the 20th century, the possibility to further improve their properties and expand their applications was explored by combining polymers with reinforcing elements. This practice has become common, enabling the definition of the composites as the reference materials of the 21st century and, thus, their occupying of an important portion of the market in the production of modern plastics [1]. The composites are designed by adding a second component to the matrix (generally polymeric) to enhance their properties and/or to achieve specific functions [2]. Among the various composites, the organic–inorganic hybrid materials offer much better performance than their non-hybrid counterparts [3]. The dramatic improvement in physical properties achieved with the incorporation of inorganic particles or nanoparticles into an organic polymeric matrix could bridge the gap between ceramics and polymers.

This Special Issue, which consists of 12 articles, including three review articles, written by research groups of experts in the field, considers recent research on polymeric composite materials.

Since increasing attention is, today, devoted to composite materials with low flammability, Majka and coworkers used the layer-by-layer (LbL) technique to form multilayered protective coatings for polyamide 6/montmorillonite (PA6/MMT) hybrid nanocomposites [4]. Their results confirmed the success in applying the LbL technique to improve the flammability characteristics of the composites under investigation, reducing the maximum point of heat release rate (PHRR).

Samal et al. investigated the interfacial adhesion of a Ni-Ti shape memory alloy with Poly (methyl methacrylate) (PMMA) as the matrix. They studied, by the means of thermomechanical analysis (TMA) and dynamic mechanical analysis (DMA), the surface pattern of the Ni-Ti channeled by a solid-state laser machine. The PMMA matrix, so modified, showed an increase in adhesion of about 80% in comparison to the free plain surface, showing, in the meantime, a reduction in the shape-memory properties of the composite material [5].

Chen and his working group, considering that the traditional fabrication methods of 3D scaffolds and cell-laden hydrogels still face many difficulties and challenges, proposed a new 3D fabrication technique exalting the concept of recycling the unutilized resource [6]. They prepared an innovative fish gelatin (FG) methacrylate polymer hydrogel mixed with a strontium-doped calcium silicate powder (FGSr) 3D scaffold via photo-crosslinking. Their mechanical assessment indicated an increase in the tensile strength of FGSr, thus making it a better candidate for future clinical applications. Furthermore, they observed good biocompatibility with human Wharton jelly-derived mesenchymal stem cells (WJMSC), as well as the enhancement of the osteogenic differentiation of WJMSC.

Weichold et al. have engaged in the challenge of preparing compact engineering composites with a combination of citric acid and glycerol. Polycondensation-type thermoset resins from natural reactants, such as citric and glutaric acid, as well as 1,3-propanediol and glycerol, were prepared and analyzed by thermogravimetric analysis (TGA), not only showing that shredded poultry feathers increased the conversion and the reaction rate of the citric acid/glycerol combination but also that increasing the amount of feathers continuously decreased the number of visible bubbles [7].
Catauro et al., by using the sol-gel method, prepared silica-based hybrid organic/inorganic amorphous composites with polycaprolactone [8]. They spectroscopically characterized the obtained composites and assessed their bioactivity and antimicrobial behavior, aiming at proposing them for bone implants.

Poly(lactic acid) (PLA)-based biocomposites reinforced with flax fibers were designed and prepared by Seggiani and coworkers by melt blending and a co-rotating conical twin-screw extruder. For the obtained materials, the Italian researchers observed good matrix/fiber adhesion and mechanical behavior in terms of break stress and composite stiffness [9].

Lan and colleagues, by mixing ferromagnetic nickel micro-powders with polyurethane (PU) shape memory polymer (SMP)/dimethylformamide solution, prepared a micron-sized protrusive PU SMP composite, curing the mixture under a low magnetic field [10]. Morphology and thermal tests were carried out by the authors to show the hybrid composites’ potential applications for micro-electro-mechanical systems (MEMS) and biomedical devices.

Polydimethylsiloxane (PDMS)-based composites were fabricated by Sheng et al. to study their optical transmittance properties. With a simple production process, the Chinese researchers checked the materials’ transmittance by varying the microcrystalline graphite powder concentration or the composite film’s thickness, thus obtaining a wide range of transmittance properties [11].

Quan and coworkers designed a new hybrid catalyst based on activated carbon (AC)-supported sulfonated cobalt phthalocyanine (AC-CoPcS) [12]. Firstly, they spectroscopically investigated the prepared catalyst to characterize its structure and then its catalytic performance, finding superior behavior in terms of yield and purity with good industrial application prospects.

The first of the three reviews in this Special Issue is by Samal and colleagues, who present the most outstanding advances in the rheological performance of magneto-rheological elastomer (MRE) composites. They focus on filler distribution, arrangement and wettability within elastomer matrices, and their contribution towards the performance of the mechanical response when subjected to a magnetic field are evaluated. Particular attention is devoted to the understanding of their internal micro-structures, filler–filler adhesion, filler–matrix adhesion and the viscoelastic behavior of the MRE composite under static (valve), compressive (squeeze) and dynamic (shear) modes [13].

A short review, on the effect of surfactants on the mechanico-thermal properties of polymer nanocomposites, was then proposed by Shamsuri and Jamil [14], highlighting polymer nanocomposites as a function of the surfactants used in their modification, namely surfactant-modified inorganic nanofiller/polymer nanocomposites and surfactant-modified organic nanofiller/polymer nanocomposites. The effect of surfactants on their mechanical and thermal properties is also shortly reviewed, with an attempt to capture the interest of the polymer composite researchers and encourage the further enhancement of new theories in this research field.

Finally, Qin et al., focus their attention on the progress in hybrid solar cells based on solution-processed organic and semiconductor nanocrystals, analyzing perspectives on the device design [15]. They give a brief introduction to the progress on solution-processed organic/inorganic semiconductor hybrid solar cells, including a summary of the development of hybrid solar cells in recent years, the strategy of creating hybrid solar cells with different structures and the incorporation of new organic hole transport materials, with new insights into device processing for high efficiency.

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References
1. Blanco, I. The Rediscovery of POSS: A Molecule Rather than a Filler. Polymers 2018, 10, 904. [CrossRef] [PubMed]
2. Pielichowski, K.; Majka, T.M. Polymer Composites with Functionalized Nanoparticles: Synthesis, Properties, and Applications; Elsevier Inc.: Amsterdam, The Netherlands, 2019; pp. 1–504.
3. Lazzara, G.; Cavallaro, G.; Panchal, A.; Fakhrullin, R.; Stavitskaya, A.; Vinokurov, V.; Lvov, Y. An assembly of organic-inorganic composites using halloysite clay nanotubes. Curr. Opin. Colloid Interface Sci. 2018, 35, 42–50. [CrossRef]
4. Majka, T.M.; Witek, M.; Radzik, P.; Komisarz, K.; Mitoraj, A.; Pielichowski, K. Layer-by-Layer Deposition of Copper and Phosphorus Compounds to Develop Flame-Retardant Polyamide 6/Montmorillonite Hybrid Composites. *Appl. Sci.* 2020, 10, 5456. [CrossRef]

5. Samal, S.; Tyc, O.; Heller, L.; Sittner, P.; Malik, M.; Poddar, P.; Catauro, M.; Blanco, I. Study of Interfacial Adhesion between Nickel-Titanium Shape Memory Alloy and a Polymer Matrix by Laser Surface Pattern. *Appl. Sci.* 2020, 10, 2172. [CrossRef]

6. Yu, C.-T.; Wang, F.-M.; Liu, Y.-T.; Lee, A.K.-X.; Lin, T.-L.; Chen, Y.-W. Enhanced Proliferation and Differentiation of Human Mesenchymal Stem Cell-laden Recycled Fish Gelatin/Strontium Substitution Calcium Silicate 3D Scaffolds. *Appl. Sci.* 2020, 10, 2168. [CrossRef]

7. Brenner, M.; Popescu, C.; Weichold, O. Anti-Frothing Effect of Poultry Feathers in Bio-Based, Polycondensation-Type Thermoset Composites. *Appl. Sci.* 2020, 10, 2150. [CrossRef]

8. Catauro, M.; Piccolella, S.; Leonelli, C. FT-IR Characterization of Antimicrobial Hybrid Materials through Sol-Gel Synthesis. *Appl. Sci.* 2020, 10, 1180. [CrossRef]

9. Aliotta, L.; Gigante, V.; Coltelli, M.-B.; Cinelli, P.; Lazzeri, A.; Seggiani, M. Thermo-Mechanical Properties of PLA/Short Flax Fiber Biocomposites. *Appl. Sci.* 2019, 9, 3797. [CrossRef]

10. Lan, X.; Huang, W.; Leng, J. Shape Memory Effect in Micro-Sized Shape Memory Polymer Composite Chains. *Appl. Sci.* 2019, 9, 2919. [CrossRef]

11. Wang, Q.; Sheng, B.; Wu, H.; Huang, Y.; Zhang, D.; Zhuang, S. Composite Films of Polydimethylsiloxane and Micro-Graphite with Tunable Optical Transmittance. *Appl. Sci.* 2019, 9, 2402. [CrossRef]

12. Cheng, Z.; Dai, M.; Quan, X.; Li, S.; Zheng, D.; Liu, Y.; Yao, R. Synthesis and Catalytic Activity of Activated Carbon Supported Sulfonated Cobalt Phthalocyanine in the Preparation of Dimethyl Disulfide. *Appl. Sci.* 2019, 9, 124. [CrossRef]

13. Samal, S.; Škodová, M.; Abate, L.; Blanco, I. Magneto-Rheological Elastomer Composites. A Review. *Appl. Sci.* 2020, 10, 4899. [CrossRef]

14. Shamsuri, A.A.; Jamil, S.N.A.M. A Short Review on the Effect of Surfactants on the Mechanico-Thermal Properties of Polymer Nanocomposites. *Appl. Sci.* 2020, 10, 4867. [CrossRef]

15. Xie, S.; Li, X.; Jiang, Y.; Yang, R.; Fu, M.; Li, W.; Pan, Y.; Qin, D.; Xu, W.; Hou, L. Recent Progress in Hybrid Solar Cells Based on Solution-Processed Organic and Semiconductor Nanocrystal: Perspectives on Device Design. *Appl. Sci.* 2020, 10, 4285. [CrossRef]

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