

Editorial

Special Issue “Physics and Mechanics of New Materials and Their Applications 2020”

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Material science, including design, manufacture, research, development and application of new materials and composites, is the one of the most quickly developing and important scientific directions of science, techniques and technologies. Devices and technical solutions, based on a wide spectrum of advanced materials, covering different scale levels, find particular interest and proposition in modern industry, where they are required to solve the problems of high loads, aggressive media and extremal chemical, physical and mechanical conditions. New scientific areas also depend directly on specific properties of used novel materials.

This Special Issue consists of six papers, including promising results, presented at the 2020 International Conference on “Physics, Mechanics of New Materials and Their Applications” (PHENMA-2020), which took place in Kitakyushu (Japan), 26–29 March 2021 (<http://www.phenma2020.sfedu.ru/>, accessed on 29 August 2022).

Mailyan et al. [1] presented methods and reported methodology for experimental studies of the variatropy of the annular cross-sections of vibrated, centrifuged and vibro-centrifuged concretes to determine their integral (common) and differential (differing in layers) strength and strain characteristics and also deformation diagrams. It has been proved that with vibro-centrifugation it becomes possible to obtain concretes with improved structure and higher characteristics, compared with centrifugation and vibration techniques. Stel'makh et al. [2] estimated the influence of the geometric parameters of the mixer on the mixing process for a foam concrete mixture, the construction of the mixing body, its location in the mixer bulk, and the mixer shape and geometry. The technique of calculating the power spent on mixing the foam concrete mixture was described. The optimal values of the angle of the mixer conical part for the preparation of foam concrete mixture have been determined. Andryushin et al. [3] stated the reasons for the high electrical conductivity of bismuth ferrite, which were due to its natural composite structure, structural non-stoichiometry, redox processes and the boundary position in the perovskite family. It has been shown that it was possible to significantly (2–3 orders of magnitude) reduce the conductivity of BiFeO₃ by introducing large-sized ions of rare-earth elements in amounts of up to 10 mol %. Dong et al. [4] used the minimum energy theory, the minimum energy dissipation theory and the nonlinear numerical optimization algorithm to calculate the advancing/receding contact angles, the initial front/rear contact angles and the dynamic front/rear contact angles for a droplet on a rough surface. It was approved that the proposed models were promising as novel design approaches of hydrophilic functional rough surfaces, applied frequently to manipulate droplets in microfluidic chips. Lin et al. [5] discussed a design of chaos-based synchronized dynamic keys and developed an improved chaos-based advanced encryption standard (AES) algorithm with the proposed



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synchronized random keys. In the proposed design, by introducing the synchronization technology of chaotic systems, the static key became dynamic and random, and it did not need to be kept or transmitted in open channels. The developed chaos-based AES algorithm has been applied to construct a novel image encryption algorithm. Fang et al. [6] reported a new integrated optical design for an automotive headlight system with the rod lens, gradient-index lens and freeform lens to expand the laser beam in modern technology. With regard to the diffusion of the beam by reflection and refraction, the liquid lens was used as a switch for the high beam and low beam lights to meet the needs of vehicle lighting functions and to use low-power diode lasers to synthesize the array light source.

Although submissions for this Special Issue have been closed, more in-depth research in the field of advanced materials, composites and their applications continue to address the challenges we face today, relating to quickly changing technologies and industry.

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