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Editorial

Editorial for the Special Issue "Heat Transfer Enhancement and Fluid Flow Features Due to the Addition of Nanoparticles in Engineering Applications"

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This Special Issue titled "Heat Transfer Enhancement and Fluid Flow Features Due to the Addition of Nanoparticles in Engineering Applications" comprises nine original research articles devoted to recent advances, as well as up-to-date progress, in all areas of heat transfer due to the addition of different types of nanoparticles in engineering and its influence on emerging technologies.

The application of nanofluids which are fluids including suspended solid particles with diameters below 100 nm has clearly increased since the past two decades. Nanofluids are considered as potential working fluids to improve heat transfer characteristics compared with conventional fluids due to the high thermal conductivity of the suspended particles. Furthermore, they are ideally suited for practical applications in distinct domains due to their remarkable characteristics. Thermal systems are one of the most important parts of various industries, which have always been researched due to their cooling abilities and improved efficiency.

Because of the wide applications of natural convection in cooling industrial tools, this challenging topic has gathered the attention of many researchers. Natural convection has wide applications in various industries and technologies such as growing crystals, cooling microchips, oil extraction, solar collectors, voltage increase transformers, etc. The optimization of heat transfer devices for reaching higher levels of efficiency requires the miniaturization of devices and increased heat transfer per unit surface at the same time. In tandem, this Special Issue highlights the techniques for enhancing convective heat transfer, including passive techniques such as treated surfaces, rough surfaces, extended surfaces, displaced enhancement devices, swirl flow devices, coiled tubes, surface tension devices, and additives for fluids such as nanoparticles.

Al Owidh et al. [1] performed a comprehensive analytical approach of integral transforms and Cardano's method for the sake of analytical solutions with a dynamic investigation of the temperature distribution and velocity field. The dynamic investigation of temperature distribution and the velocity field of thermoelectric fluid is explored on the basis of magnetization and anti-magnetization, which describes the behavior for sine and cosine sinusoidal waves.

Alfannakh et al. [2] conducted a numerical study in order to evaluate the steady natural convective heat transfer problem and entropy generation of both single-wall (SWCNT) and multi-wall (MWCNT) nanoparticles with water as a base liquid over two spaced

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spheres located between two short length plates. The effects of pertinent parameters such as Rayleigh number, inclination angle of the plates, nanoparticles type and the volume fraction of nanoparticles on the fluid flow and heat transfer rates are discussed and analyzed by the authors in details. The thermal performance of their physical domain is also evaluated through the ecological coefficient of performance (ECOP). Souayeh et al. [3] optimized the conjugate heat transfer and thermal-stress analysis for hydromagnetic Brinkman fluid with chemical reaction in permeable media. Non-Newtonian Brinkman fluid with exponential boundary conditions was analyzed with help of Fourier sine and Laplace transforms. Khan et al. [4] documented a particularly helpful study regarding the shear banding phenomena in the non-isothermal simple shear flow of a viscoelastic-fluid-based nanofluid (VFBN) subject to exothermic reactions. In fact, the authors modeled the polymeric (viscoelastic) behavior of the VFBN via the Giesekus constitutive equation, with appropriate adjustments to incorporate both the non-isothermal and nanoparticle effects.

In the same context of heat transfer enhancement, Souayeh et al. [5] investigated the mixed convective flow based on carbon nanotubes suspended in ethylene glycol and derived by means of Fourier sine transform. Authors analyzed the thermophysical properties of nanofluid, the temperature and velocity profiles through fractional derivative and integral transforms. Then, a comparative analysis of single and multiwalled carbon nanotubes was presented for the sake of enhancement of heat transfer. The augmentation of heat transfer in a circular channel with inline and staggered baffles was performed numerically by Al Nuwairan and Souayeh [6]. sake As a result, the effects of the position of baffles in the shape of a circle's segment placed inside a circular channel to improve the thermal and flow performance of a solar air heater has been considered. Meena et al. [7] conducted a review on boiling heat transfer enhancement techniques. The purpose of their review was to analyze, discuss, and compare existing research on boiling heat transfer enhancement techniques from the last few decades. The authors sought to explain the effect of nucleation sites on plain and curved surfaces and on heat transfer enhancement, to suggest future guidelines for researchers to consider. Another review paper was written by Yasmin et al. [8]. In this review paper, the authors explored the literature survey to highlight the trend in mono or hybrid nanofluid formulation presently documented as the norm, with the possibility of changing the status quo. In their research paper, Ullah et al. [9] investigated the hydrothermal characteristics of ($Ag + TiO_2 + H_2O$) hybrid nanofluid in three-dimensional flow between two vertical plates, in which the right permeable plate stretches as well as rotates, by employing varying magnetic, heat and radiation fluxes.

Nowadays, technologies search for the highest efficiency, mainly for energy saving, particularly concerning cooling or heat dissipation challenges within devices and electronic components. Many fascinating properties of nanofluids have been reported for many years. However, the reader should be aware of the challenges of nanofluids. From these challenges, we may mention the agglomeration of nanoparticles due to molecular interactions such as van der Waals forces, the higher production cost of nanofluids which may hinder the applications of nanofluids in the industry, the difficulty in the production process and increased pressure drop and pumping power, etc.

To conclude, the remarkable advancements documented regarding heat transfer enhancement and fluid flow features due to the addition of nanoparticles highlights the significance of the high practical applicability potential of these enhancements in different engineering applications. We hope that this Special Issue will act as a guideline for future perspectives to be explored with respect to this particular research domain.

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