symmetry

MDPI

Editorial

Dispersed Systems: Physics, Optics, Invariants, Symmetry

Olga B. Kudryashova

Institute for Problems of Chemical and Energetic Technologies, Siberian Branch of the Russian Academy of Sciences (IPCET SB RAS), 659322 Biysk, Russia; olgakudr@inbox.ru; Tel.: +7-(905)-924-54-44

check for updates

Citation: Kudryashova, O.B. Dispersed Systems: Physics, Optics, Invariants, Symmetry. *Symmetry* **2022**, *14*, 1602. https://doi.org/10.3390/sym14081602

Received: 1 August 2022
Accepted: 2 August 2022
Published: 4 August 2022

Disperse systems are widely used in technology (medicine, food science, oil refining, metallurgy, etc.) and everyday life [1–6]. We study dispersed systems when we care about the environment and want to get rid of harmful aerosols or suspension pollution [7–9]. The study of the characteristics of aerosol media is of particular importance when ensuring normal life activity, which places high demands on the cleanliness of the airspace of industrial and residential premises. At the same time, such problems as the determination of the dispersal parameters of aerosol media in closed volumes of various devices and local areas of industrial, administrative, and residential buildings come to the fore.

Dispersed systems, as systems in two-phase and multi-phase states, exhibit many new properties compared to a continuous medium [10–12]. In addition, the dynamics of dispersed systems during their interaction with physical fields [13], in the process of chemical transformations, combustion [14,15] is of interest.

There are fundamental and applied problems associated with measuring the size and concentration of particles in a dispersion medium. Optical measurement methods imply the development of the optics of disperse systems, in which the symmetry or asymmetry of the radiation scattering indicatrix plays an important role [16,17].

This special issue contains works devoted to the study of dispersed systems and the role of the concept of symmetry in the physics, mechanics, and optics of systems.

In the work of a group of scientists involved in the visualization of the combustion of metal nanoparticles, the possibilities of optical methods for monitoring the combustion surface of particles are shown [18]. Impressive video materials of fast particle combustion processes have been obtained. The central symmetry of the propagation of the combustion wave front and the formation of combustion products in a thermite mixture of nanoaluminum and iron oxide are found. This is a consequence of the symmetry of the properties of the system under study at the micro- and macrolevels.

The next work explores the effect of high-intensity ultrasound on the process of coagulation of particles of a gas-dust dispersed system [19]. This problem arises when particles are removed from the carrier gas stream. The symmetry of the applied field is important for the efficiency of coagulation and gas purification from particles. It has been found that ultrasound has a particularly strong effect on fairly concentrated disperse systems.

The following works [20,21] deal with the mathematical aspect of the concept of symmetry in problems related to disperse systems. It should be noted that symmetry issues often arise in the problems of processing measurement information about disperse media, especially in the application of optical remote diagnostic methods [22].

In [20], the polarimetry method is considered a tool for the nondestructive analysis of the properties of dispersed systems, such as aerosols and hydrosols. The authors have developed a universal Muller matrix synthesizer based on the concept of a polarizing ellipsoid, for which symmetry features are important.

In a more general sense, the work [21] considers the symmetry of a physical system as its property, which is preserved after transformations are carried out on it. In a physical system, including a dispersed system, there are unchanging invariants that are studied by the similarity theory. The review is devoted to the motion of aerosol particles, including those under the influence of external fields, with particular attention to problems related to the theory of similarity and invariants. The results of the work have something in common with the topic of works [13,19], in part, concerning the effect of ultrasound on the aerosol system.

Although the articles collected here do not cover the entire spectrum of the concept of symmetry as applied to dispersed systems, it becomes clear that the concept of symmetry is important when applied to such systems. This manifests itself in methods for measuring the characteristics of particles in aerosols, suspensions, etc., as well as in the mathematical description of the dynamics of dispersed media.

Funding: This research received no external funding.

Conflicts of Interest: The author declares no conflict of interest.

References

1. Schubert, H.; Ax, K.; Behrend, O. Product engineering of dispersed systems. *Trends Food Sci. Technol.* **2003**, *14*, 9–16. [CrossRef]
2. Hickey, A.J.; Mansour, H.M. *Inhalation Aerosols: Physical and Biological Basis for Therapy*; CRC Press: Boca Raton, FL, USA, 2019; Volume 1.
3. Diot, P. Aerosols in Medicine: Principles, Diagnosis, and Therapy. *Chest* **1995**, *108*, 16–17.
4. Glagoleva, O.F.; Kapustin, V.M. Improving the efficiency of oil treating and refining processes. *Pet. Chem.* **2020**, *60*, 1207–1215. [CrossRef]
5. Frantsevich, I.N. The place of powder metallurgy in contemporary material science and technology. *Powder Metall. Met. Ceram.* **2000**, *39*, 334–344. [CrossRef]
6. He, J. *Nanostructured Materials: Synthesis, Properties and Applications*; Nova Science Publishers: New York, NY, USA, 2019.
7. Casazza, M.; Lega, M.; Liu, G.; Ulgiati, S.; Endreny, T.A. Aerosol pollution, including eroded soils, intensifies cloud growth, precipitation, and soil erosion: A review. *J. Clean. Prod.* **2018**, *189*, 135–144. [CrossRef]
8. Levin, Z.; Cotton, W.R. *Aerosol Pollution Impact on Precipitation: A Scientific Review*; Springer Science & Business Media: New York, NY, USA, 2008.
9. Bauer, S.E.; Tsigaridis, K.; Miller, R. Significant atmospheric aerosol pollution caused by world food cultivation. *Geophys. Res. Lett.* **2016**, *43*, 5394–5400. [CrossRef]
10. Matveenko, V.N.; Kirsanov, E.A. The viscosity and structure of dispersed systems. *Mosc. Univ. Chem. Bull.* **2011**, *66*, 199–228. [CrossRef]
11. Dorokhov, V.; Hauser, Y. Polymer composite materials as dispersed systems. *Rev. Incl.* **2020**, *7*, 580–586.
12. Garti, N. *Thermal Behavior of Dispersed Systems*; Marcel Dekker: New York, NY, USA, 2001.
13. Kudryashova, O.; Vorozhtsov, S. On the mechanism of ultrasound-driven deagglomeration of nanoparticle agglomerates in aluminum melt. *JOM* **2016**, *68*, 1307–1311. [CrossRef]
14. Soo, M.; Mi, X.; Goroshin, S.; Higgins, A.J.; Bergthorson, J.M. Combustion of particles, agglomerates, and suspensions—A basic thermophysical analysis. *Combust. Flame* **2018**, *192*, 384–400. [CrossRef]
15. Yongqiang, X.; Baojiao, G.; Jianfeng, G. The theory of thermodynamics for chemical reactions in dispersed heterogeneous systems. *J. Colloid Interface Sci.* **1997**, *191*, 81–85. [CrossRef]
16. Kokhanovsky, A.A. *Aerosol Optics: Light Absorption and Scattering by Particles in the Atmosphere*; Springer Science & Business Media: New York, NY, USA, 2008.
17. Kudryashova, O.B.; Akhmadeev, I.R.; Pavlenko, A.A.; Arkhipov, V.A.; Bondarchuk, S.S. A method for laser measurement of disperse composition and concentration of aerosol particles. *Key Eng. Mater.* **2010**, *437*, 179–183. [CrossRef]
18. Li, L.; Gubarev, F.; Mostovshchikov, A. Synchronized Two-Camera Laser Monitor for Studying Combusting Powder Systems. *Symmetry* **2022**, *14*, 656. [CrossRef]
19. Khmelev, V.N.; Nesterov, V.A.; Bochenkov, A.S.; Shalunov, A.V. The Limits of Fine Particle Ultrasonic Coagulation. *Symmetry* **2021**, *13*, 1607. [CrossRef]
20. Gil, J.J.; José, I.S. Universal synthesizer of Mueller matrices based on the symmetry properties of the enpolarizing ellipsoid. *Symmetry* **2021**, *13*, 983. [CrossRef]
21. Kudryashova, O.B.; Pavlenko, A.A.; Titov, S.S. Symmetry in Aerosol Mechanics. *Symmetry* **2022**, *14*, 363. [CrossRef]
22. Xu, R. *Particle Characterization: Light Scattering Methods*; Kluwer Academic Publishers: New York, NY, USA, 2002.