liquids

MDPI

Editorial

Nanocarbon–Liquid Systems

Nikolay O. Mchedlov-Petrossyan

Department of Physical Chemistry, V. N. Karazin Kharkiv National University, 61022 Kharkiv, Ukraine; nikolay.mchedlov@gmail.com

The rapid development of nanotechnology has necessitated a more detailed physicochemical investigation of dispersed systems of various compositions and types. Among such systems, nanocarbon dispersions occupy an important place. This Special Issue brings together five articles, including both reviews and reports on original experimental research on nanocarbons and related 2D-materials. These papers address various aspects of nanochemistry and demonstrate the diversity of challenges that arise in the study of 0D, 1D, and 2D-prolonged dispersed systems.

The current state of physical chemistry of liquid crystals doped with carbon nanotubes is reviewed [1]. Systematization and analysis are presented for the integration of single- and multi-walled carbon nanotubes in thermotropic (nematic, smectic, cholesteric, and ferroelectric, etc.) and lyotropic liquid crystals. Particular attention is paid to alignment effects and supramolecular organization arising from the orientational interaction between carbon nanotubes and a liquid-crystalline matrix. Also discussed are effects arising from specific intermolecular and interparticle interactions, as well as interesting microstructural, electromagnetic, percolation, optical, and electro-optical properties.

Two papers are devoted to fullerenes in liquid media [2,3]. An experimental study on the formation of C_{70} fullerene clusters in a binary xylene/tetrahydrofuran solvent system was conducted using optical absorption, refractometry, and dynamic light scattering techniques. A correlation was established between changes in the refractive index of the C_{70}/xylene/tetrahydrofuran solution and the degree of C_{70} molecular clustering, as well as the solution concentration and the duration of its storage. These findings should help elucidate the mechanisms governing the behavior of fullerenes, which is significant for ongoing research in liquid media.

Another article provides an overview of the colloid chemistry of fullerenes in water and organic solvents [4]. While the use of non-equilibrium dissolution methods in so-called "good" solvents (predominantly non-polar aromatic liquids) leads to the formation of colloidal aggregates, the application of equilibrium dissolution methods makes it possible to obtain molecular solutions. The latter, however, exhibit rather unusual properties; new findings discussed in this review support earlier hypotheses that such molecular solutions possess certain colloidal characteristics. In polar (poor) solvents, lyophobic colloidal systems can be prepared using either a "bottom-up" or a "top-down" approach. New data concerning coagulation by electrolytes are discussed in detail. Organosols in acetonitrile and methanol follow the Schulze–Hardy rule and are significantly less stable toward electrolytes than fullerene hydrosols. The latter are typical hydrophobic colloids. The pronounced difference in the stability of fullerene organosols and hydrosols allowed assuming a substantial stabilizing non-DLVO factor for fullerene aggregates in water. Analysis of the behavior of fullerenes in dimethylsulfoxide, dimethylformamide, and *N*-methylpyrrolidine-2-one allows for the conclusion that these basic solvents represent a subset of poor solvents with some features of so-called reactive solvents. They dissolve fullerenes quite easily and

Check for updates

Received: 20 November 2026
Accepted: 22 November 2026
Published: 28 November 2026

Copyright: © 2026 by the author. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license.

with less energy consumption and, thus, the obtained organosols exhibit high stability against electrolytes.

Along with graphene and its derivatives, boron nitride nanosheets—also referred to as "white graphene"—have become a subject of intense scientific interest [4]. Unlike graphene, which typically exhibits electrical conductivity, boron nitride nanosheets are 2D nanomaterials with the opposite property: they are electrical insulators. However, their tendency to aggregate and their weak interfacial interaction with a polymer matrix limit their effectiveness in enhancing thermal conductivity. To address these issues, chemical modification has been employed, which has improved both the dispersion of the material and its compatibility with the polymer matrix. In this work, it is demonstrated the successful covalent modification of boron nitride nanosheets using (3-aminopropyl)dimethylmethoxysilane, (3-aminopropyl)diethoxymethylsilane, and (3-aminopropyl)trimethoxysilane. IR spectroscopy, SEM/EDS, and UV spectroscopy confirm successful functionalization and show that the number of alkoxy groups in the silane significantly influences the formation of a siloxane network and the degree of surface coverage of the BNNS.

Presently, graphene oxide has been successfully used as a filler to modify various properties of polymers and fiber-reinforced composites [5]. In this work, for the first time, graphene oxide was introduced into the highly viscous DEN-438 epoxy novolac resin, and rheological properties of the resulting compositions were investigated. The behavior of the prepared formulations compared to typical graphene oxide/epoxy mixtures is unusual. At low graphene oxide content, the resin viscosity decreases; after a threshold content, viscosity increases with the graphene oxide content. This phenomenon is explained by the formation of the liquid crystalline structure. At higher concentrations of graphene oxide, the compositions changed their state: at rest, they behaved like solids, while under load, they acted like liquids—properties that are highly sought after for binders used in film coatings. The discovered properties of these modified epoxy resin formulations suggest their potential use as the new generation of film binders for Resin Film Infusion technology.

It is to be hoped that the issues raised here will serve as a stimulus for further research in this field.

Data Availability Statement: No new data were created or analyzed in this study. Data sharing is not applicable to this article.

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

References

1. Lisetski, L.; Bulavin, L.; Lebovka, N. Effects of Dispersed Carbon Nanotubes and Emerging Supramolecular Structures on Phase Transitions in Liquid Crystals: Physico-Chemical Aspects. *Liquids* **2023**, *3*, 246–277. [CrossRef]
2. Makhmanov, U.K.; Esanov, S.A.; Sidigaliyev, D.T.; Musurmonov, K.N.; Aslonov, B.A.; Chuliev, T.A. Behavior of C_{70} Fullerene in a Binary Mixture of Xylene and Tetrahydrofuran. *Liquids* **2023**, *3*, 385–392. [CrossRef]
3. Mchedlov-Petrossyan, N.O.; Marfunin, M.O.; Kriklya, N.N. Colloid Chemistry of Fullerene Solutions: Aggregation and Coagulation. *Liquids* **2024**, *4*, 32–72. [CrossRef]
4. Goni, F.; Chemelli, A.; Uhlig, F. Towards Hybrid 2D Nanomaterials: Covalent Functionalization of Boron Nitride Nanosheets. *Liquids* **2025**, *5*, 31. [CrossRef]
5. Amirova, L.M.; Khannanov, A.; Dimiev, A.M.; Amirov, R.R. The Rheology of Graphene Oxide Dispersions in Highly Viscous Epoxy Resin: The Anomalies in Properties as Advantages for Developing Film Binders. *Liquids* **2025**, *5*, 32. [CrossRef]

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.