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Preface

Sonoprocessing of materials (Special issue)

Ultrasound-assisted technologies are experiencing a surge in research and development. This is clearly seen in the example of sonochemistry that has been originally developed to exploit cavitation-related phenomena aiming at enhancing chemical reactions mainly due to formation of highly active radicals like hydroxyl (HO•) and hydroperoxyl (HOO•) in aqueous media. Over the years, this field has undergone significant growth and development, and now includes a wide range of areas such as preparation of emulsions, synthesis and dispersion of nanoparticles and nanospheres, treatment of contaminated surfaces, etc. The expansion and significance of the field can be well illustrated by the impact factor growth of the flagship journal Ultrasonics Sonochemistry that has increased from around 0.95 in 2000 to 9.34 in 2021. The annual citations to this journal have increased from 125 in 2000 to 12,400 in 2021.

There is, however, another group of ultrasound-assisted processes, which have received considerable attention recently, that deals with physical effects of ultrasound rather than ultrasonically stimulated chemical reactions. Examples include, but are not limited to, ultrasonic degassing and solidification of molten metals, synthesis of composite materials, metal joining, agglomeration and de-agglomeration of particulates, fragmentation of crystals, atomization, exfoliation of nanomaterials, additive manufacturing, high-precision machining and welding. It is to be noted that many of these processes have been proposed and examined for a very long time. Indeed, as early as the 1920 \xA0s, R. Wood and A. Loomis have conducted the first experiments on the ultrasonic atomization of liquids, the emulsification of immiscible liquids, and the structural changes in crystallized organic substances. Then, several years later, in 1935, S. J. Sokolov has conducted a pioneering experimental research on the crystallization of low-melting metals under conditions of ultrasonic irradiation.

Since that time, a great number of studies, both fundamental and applied, have been performed to shed light on the ultrasound-related effects and the underlying mechanisms. For example, when ultrasound waves propagate through molten metals, the acoustic cavitation and streaming play a primary role in achieving the desirable ultrasonic effects, similar to those of aqueous media. However, in applications where ultrasound energy is delivered into gas or solid phases, it is not cavitation but quite different physical phenomena that are responsible for the ultrasonic effects. Another promising area where ultrasound waves can be beneficial is controlling interface phenomena. It is well known that when waves are incident upon an interface, the reflecting or scattering of the waves from the interface is responsible for a number of nonlinear phenomena that occur, affecting surface energy. These provide a unique tool for controlling the rates of the interfacial heat and mass transfer. In line is the cavitation-assisted production of 2D nanomaterials that have attracted a great deal of attention from the scientific community with efforts focused on harnessing dynamic interaction of cavitation with 2Ds and optimizing their production at a scale. New technical means of studying the physical phenomena upon ultrasonic processing, such as direct acoustic pressure measurements in a range of temperatures, particle-image velocimetry and ultra-high speed imaging in optical and X-rays spectra, revealed intricate mechanisms of interaction between cavitation bubbles, shockwaves, and acoustic streaming with solid and liquid phases. These mechanisms helped to inform advanced physics-based numerical models that now cover a range of spatial and temporal scales.

Currently, the above mentioned and other ultrasonics related topics tend to be dispersed through a range of different journals and, hence, appear unconnected even though they all contain ultrasonic processing as their core subject. It is worth noting that papers on some of such topics do appear occasionally in regular issues of Ultrasonics Sonochemistry but, not as contributions to the main scope of the journal, as they go beyond the chemistry (core subject) related phenomena. This motivated us to propose and launch this Special Issue aiming at attracting papers on a wider range of topics related to Sonoprocessing of Materials with a view of becoming an established trend in the Journal and promote links and collaborations between scientists with complementary interests.

This issue attracted a lot of interest and a healthy number of accepted papers on a wide range of topics. We hope that these topics will continue to be covered by Ultrasonic Sonochemistry and, in some not so distant future, will be incorporated in the scope.

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