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Preface to Acoustic cavitation and sonoluminescence. A theme compiled and edited by J. R. Blake

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Preface

Intensive insonification of liquids can generate cavitation bubbles. The bubbles collapse violently, and in doing so generate high temperatures and pressures within the gaseous contents. This can lead to a reactive chemical environment as well as the often observed pulse of light near the end of the collapse phase of the bubble oscillation. Research studies have concentrated on either an isolated single bubble or clouds of many bubbles. The acoustic cavitation bubble is likely to be near-spherical in single-bubble sonoluminescence (SBSL), with almost an indefinite number of oscillations being observed, while in multibubble sonoluminescence (MBSL) it will more likely be non-spherical, with only a small number of oscillations before it breaks up. High temperatures of 10^4–10^5 K have been measured in SBSL while an order of magnitude lower (10^3–10^4 K) are more typical of MBSL. The chemical constituents of the bubble interior are also different, typically argon in many of the SBSL experimental studies, while in MBSL they are related to the vapour of the liquid solution, each of the constituents being identified by the different spectral characteristics. Clearly, such a potentially chemically reactive environment has attracted significant attention from chemists and industrialists, as well as the innate scientific curiosity with such seemingly simple observable phenomena.

Nevertheless, the phenomenon is much more complicated than first thought and the complex nonlinear mathematics, physics and chemistry make acoustic cavitation and sonoluminescence an exciting area of research. The aim of this issue is to show the excitement of this evolving field by introducing the physico-mathematical modelling of a spherical bubble in SBSL, followed by the understanding arising from experimental studies, the development of non-spherical bubble phenomena which are the basis for the study and understanding of shock phenomena and luminescence. Bubbles in MBSL occur in large numbers and their interaction is important with regard to applications in sonochemistry and industry. Within this field of study, an opportunity exists to provide solutions, provided laboratory studies can be scaled up to the industrial level, to a range of chemical, metallurgical and environmental problems that are due to the enormous pressures and temperatures that can be generated inside the cavitation bubble.

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