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Ultrasound-assisted Liquid Antisolvent Precipitation for the Production of Nanoparticles †

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Abstract: Synthesis of nanoparticles with controlled size, shape, and composition remains a challenge. Novel technologies combined acoustic power for the continuous precipitation of nanoparticles both in drug and gene delivery have been reported in the literature. Owning the advantages of well-controlled flow patterns and increased surface-to-volume ratios, the Small scale flow reactors, namely micro and milli-reactors, over conventional reactors. This microfluidics provides an ideal platform to work with inherent safety, allowing to perform reactions at elevated temperatures, pressures, so these become a precedence opportunity for the continuous synthesis of pharmaceuticals APIs'. At the same time, the complexities arise dealing with such a microfluidic environment, namely, weak convective mixing and issues regarding solid handling. Integrating ultrasound with small-scale flow reactors has been the talk of the town to address clogging and mixing issues. Ultrasonic drug and gene delivery from nanocarriers are effective because of the wide variety of drugs and genes that could be delivered to the targeted tissues by fairly noninvasive means—dealing with the ultrasonic field, where cavitation bubbles rise and eventually undergo vigorous translational motion and surface oscillation. Ultrasonic irradiation contributes to acoustic cavitation and micro/ macro-streaming, i.e., the generation, growth, and collapse of microbubbles; as a result, there is a decrease in the Nernst diffusion layer thickness, the improvement of the overall mass transport due to turbulence, faster reaction rates, and efficient cleaning and degassing of the electrode surface. Transient collapsing of bubble follows the adiabatic process results in tremendous energy within the bubble. When the microscopic bubbles collapse close to the surface of the solid substrate, the larger particles split into smaller ones or deagglomerate nanoparticles. In this paper, the synthesis of albendazole drug nanoparticles in a liquid antisolvent process in the presence of ultrasound has been studied. The effect of ultrasonic energy on drug the size and morphology of drug particles under various parametric conditions has been investigated. The particle size was found to be 564.3 nm with corresponding PDI .389.

Keywords: liquid antisolvent precipitation; ultrasonic energy; drug nanoparticles.

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Conflicts of Interest

The authors declare no conflict of interest to influence the work reported in this paper. The funders had no role in the design of the study, in the collection, analyses, or interpretation of data, in the writing of the manuscript, or in the decision to publish the results.