Acoustic Particle Separation and Sorting in Gases

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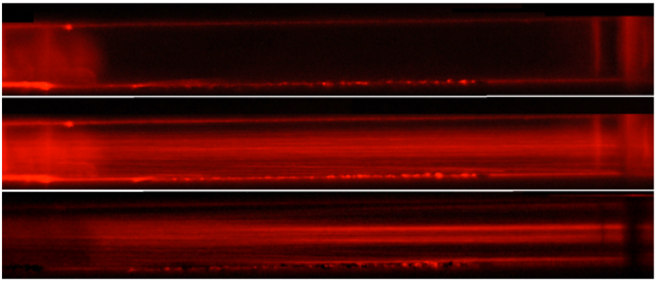

The use of an acoustic field to concentrate particles in a moving fluid offers great potential in several scientific and engineering applications. The underlying phenomenon is often called "acoustophoresis" and usually results in the particles moving towards the velocity nodes of a standing wave. Mature separation and sorting technique based on the same principle are now available in liquid phase microfluidic systems, mostly aimed at biomedical applications. Attempts have recently been made to use this approach in gases to develop novel field-flow fractionation (FFF) methods for the treatment of aerosols. However, several challenges remain before such technique can offer high-throughput separation and sorting with the same capabilities as what is currently available in liquids at the microscale.

Continuous separation can be achieved by flowing the particle-laden fluid through a channel in which a standing high amplitude acoustic wave is maintained. The channel height must match half the wavelength of the frequency employed, or a few multiples of it. In gaseous flows, reasonable separation rates are obtained using a frequency of a few tens of KHz, which translates to channel a few mm to a few cm high. A simple experimental facility has already been developed and used to gather preliminary results aimed at guiding future design work. It features a broadband electrostatic transducer and a variable channel height. This project aims at increasing the fundamental understanding of acoustic particle separation in gases, with a particular attention devoted to potential applications in biomass gasification and combustion processes. Moreover, our work will cover a wide range of particle sizes down to tens of nanometers, for which the molecular nature of their interactions with the carrier gas will need to be taken into account in our modeling efforts.

E. Robert, R. Imani Jajarmi, K. Engvall and M. Steibel, Turbulence and geometric effects on the efficiency of continuous acoustic particle separation in a gas. In Proceedings of the International Conference on Multiphase Flows, Jeju, Korea, 2013.