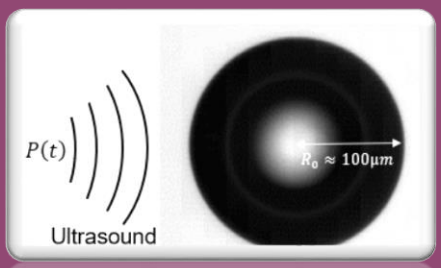
Official Seminar

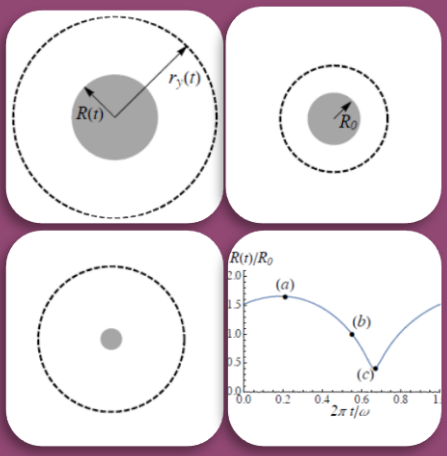
Talk on

Ultrafast deformations of yield-stress fluids imparted by ultrasound-driven microbubbles



by Dr. Marco De Corato, Imperial College, UK

Place: Small Seminar Room, 1st Floor, Main Building of Chemical Engineering Department
Date: July 17, 2018 , Time: 11:00
Organizer: The fluids Lab



Abstract

Yield-stress fluids are encountered in many industrial areas such as formulated products, oil recovery, and wastewater treatment. In these applications, small gas bubbles are often generated or trapped while processing the fluid. Once suspended in a yield-stress fluid, micron-sized bubbles are difficult to remove because their buoyancy force is below the yield stress. The presence of trapped bubbles may affect the product quality or process performance, hence methods for removal of bubbles from yield-stress fluids are desirable. We first show that is possible to measure the high-frequency properties of complex materials using microbubbles driven by ultrasounds. Next, we explore the use of ultrasound to release micron-sized bubbles from yield-stress fluids. Preliminary experiments performed in our lab suggest that micron-sized bubble can become free to escape after less than a minute of exposure to ultrasound. We hypothesize that the radial oscillations of the bubbles in the ultrasound field cause local yielding. We develop a theoretical framework to describe the deformation of yield-stress fluids by oscillating microbubbles. We modify the Rayleigh-Plesset equation governing the radial dynamics of the bubble to take into account the complex behaviour of the fluid. We characterize the amplitude of the radial oscillations of the bubble as a function of the ultrasound frequency, and for different rheological parameters, by solving the Rayleigh-Plesset equation numerically. By quantifying the volume of fluid that is yielded as a function of the amplitude and frequency of the acoustic pressure, it is possible to predict optimal conditions for bubble removal.

Keywords: bubble dynamics, yield-stress fluids, viscoelasticity.

Dr. Marco De Corato

He was born in Napoli, Italy in 1988. In 2010, he obtained a Batchelor degree in Chemical Engineering from the University of Napoli. He continued with his post-graduate studies in Chemical Engineering where he obtained a Master of Science (2013). He obtained his Ph Degree in 2016 under the supervision of Prof. Pier Luca Maffettone and Dr. Gaetano D'Avino, discussing the thesis "Theory and simulations of active and Brownian particles". From 2016 he is a postdoctoral researcher in the group of Dr. Valeria Garbin at Imperial College London. His current work focus on the modelling of ultrafast deformations of structured fluids and fluid-fluid interfaces.