Three PhD Positions at University of Limerick, Ireland: Start date – January 2022
Project: 'Factory in a Box' for Personalised Products based on Emulsions

Apply before 15th October 2021 to Professor Vivek Ranade (Vivek.Ranade@ul.ie)

Project Summary: Personalised products are gaining significant attention in many sectors across the globe. Current bulk manufacturing technologies are slow in responding to changes, capital intensive, use unsustainable methods and not flexible to meet personalisation needs. There is an urgent need to develop truly distributed manufacturing platforms which are able to manufacture on-demand and flexible to deliver personalised products with desired properties. This project aims to develop novel ways of producing personalised liquid – liquid emulsions (used widely in food, personal care, and medicine) with desired attributes using a compact and modular 'factory in a box' platform. This will be achieved by advancing fundamental knowledge on hydrodynamic cavitation and their role in producing emulsions, multi-layer models of complex multiphase flows and ensemble approaches which combine phenomenological models and machine learning for relating critical quality attributes with design and process parameters. The models, devices, soft sensors and process intensification strategies developed in this project will go beyond the application of emulsions considered in this project and it will provide a basis for realising next generation 'factory in a box' platform for personalised products. The project will be executed by a team of three PhD students supported by two post-doctoral researchers.

PhD1: will work dedicatedly on micro-scale processes in hydrodynamic cavitation. PhD1 will establish experimental set-up to investigate interactions of collapsing cavities and liquid droplet. PhD1 will also be involved in developing models of cavity dynamics and its interaction with liquid droplet.

PhD2: will focus on cavitation device scale flows and their influence on droplet breakage. PhD2 will set-up and investigate hydrodynamic cavitation device scale flow processes using experiments (visualisation, acoustic and FBRM techniques) and computational models.

PhD3: will focus on quantifying influence of hydrodynamic cavitation on critical quality attributes (CQAs) of emulsions. Droplet size distributions and other CQAs of produced emulsions will be quantitatively measured. These offline CQAs will be related with the three parameters which can be measured online (CLD, conductivity and acoustic signals). Soft sensors will be developed to relate CQAs with online measurable quantities.

Integrated table top 'factory in a box' will be established via collaboration of three PhD students and two post-docs. The team will collaborate with HZDR (x-ray tomography), University of Ljubljni (high-speed visualisation) and Teagasc (CQAs of emulsions) as well as industry collaborators (Unilever and Dolomite/ Blacktrace) and two research centres SSPC (www.sspc.ie) and Confirm (www.confirm.ie) hosted by University of Limerick. Please **apply before 15 October 2021 to Professor Vivek Ranade** (Vivek.Ranade@ul.ie). PhD positions will start at University of Limerick from January 2022.