

E&I Research Studentship project proposal 2019

Project title: Droplets processing science and technology

Supervisory team:

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Project Highlights:

- To learn and develop innovative methods to process liquid droplets
- To collaborate with industrial partners to explore the application of the new findings
- To gain experimental, modelling and simulation skills

Project Description:

Fabrication of many products requires the processing of liquid droplets. Novel droplets processing method often leads to new and better products. Some inevitable detrimental droplets in the production line of manufacturing engineering can be turned into beneficial ones if a novel processing method is invented and implemented. Examples are abundant from biochemistry engineering to metallurgical industry. The aim of this proposal is to develop innovative droplets processing science and technology to help future manufacturing engineering. This includes the development of fundamental understanding of droplets behaviours in relation to their chemical compositions and environments, manipulation of droplets using external processing conditions, and characterization of droplet properties using state-of-the-art facilities.

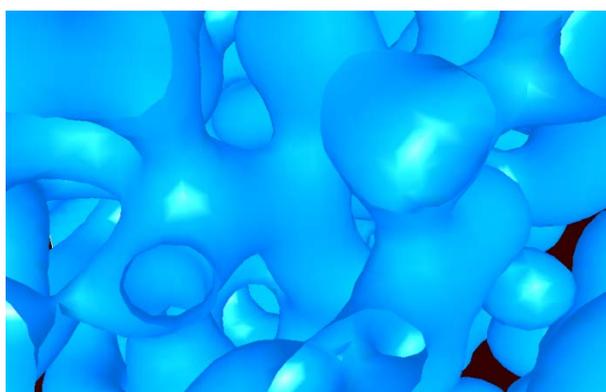


Figure 1: Formation of droplets in immiscible liquids

The supervision team has long term interests in development and application of novel complex fluid science and technology. Prof. Qin was the earliest author in development of DL_MESO code package ([link](#)) for simulation of complex fluids. The license of DL_MESO has been signed by hundreds of universities and industries so far. The further development of the code package has been funded continuously by EPSRC for 9 years with the current fund until mid 2022. The facilities for manipulation of liquid materials have been established in the laboratory and were funded by the Royal Academy of Engineering and The Royal Society. Some new findings have been adopted by UK and EU industrials for industrial trials and applications. Dr. Pradas has published many papers in this topic, including a recent work that described a new process to control how droplets dry, which was published in *Nature Communications*. Dr. Richard Moat is an expert in materials characterisation using neutron and light methods.

Research Methods:

The research will be carried out by modelling, computing and experiments. The focus can be adjusted according to the candidate's background and interests. The supervision team has covered every aspect of the required skills and they are able to provide training, guidance and support. The experimental facilities for droplets generation, electromagnetic manipulation and in-situ low resolution characterizations are installed in the research group. The faculty has high resolution characterization facilities available for use. In addition, a number of workstations are available in the research team to support small scale calculation, access to the national supercomputer is available via an on-going EPSRC grant for large scale simulation, and some computing code packages and database, as well as visualization software to support three-dimensional visual analyses, are all available for use.

Indication of project timeline:

Year 1: The PhD candidate will be trained for using various models, computational code packages and processing/characterizing facilities, carrying out literature survey, familiarizing with the project and research field, planning research details, visiting industrial collaborators for better understanding of the project.

Year 2: Intensive research to improve the scientific understanding of droplet processing, carrying out case study and benchmark investigation, developing novel ideas to improve the droplet processing and manufacturing, attending national and international workshops and conferences to exchange ideas and present new findings.

Year 3: The student will write scientific reports on the research, draft research papers and to publish in international peer-reviewed journals, advice to engineering application to the industrial collaborators, and help supervisors to draft new proposals for further research.

References

- [1] **Rongshan Qin**, "Using electric current to surpass the microstructure breakup limit", *Scientific Reports*, 7 Article 41451, (2017).
- [2] G.G. Wells, E. Ruiz-Gutierrez, Y. Le Lirzin, A. Nourry, B.V. Orme, **M. Pradas**, and R. Ledesma-Aguilar, "Snap evaporation of droplets on smooth topographies", *Nature Communications*, 9, Article 1380 (2018).
- [3] Xinfang Zhang and **Rongshan Qin**, "Electric current-driven migration of electrically neutral particles in liquids", *Applied Physics Letters*, 104, Article 114106 (2014).

Candidate Applications

Applications are open to both UK and international candidates. The position is fully funded for fees and stipend. Applicants must have the equivalent of a first class or upper second honours degree in materials, engineering, mathematics, physics or other related subjects. Start date will be 1st October 2019.

Experience in modelling, computation or experimental processing of fluids are considered as advantage but not essential. Please contact Prof. R. Qin (rongshan.qin@open.ac.uk) for further information.

Applications should include:

- a cover letter outlining why the project is of interest and how your skills match those required
- a CV including contact details of two academic references

- An Open University application form, downloadable from: <http://www.open.ac.uk/postgraduate/research-degrees/how-to-apply/mphil-and-phd-application-process> (Note: This is an Advertised studentship and you do not need to submit a proposal). Please contact Prof. Qin (rongshan.qin@open.ac.uk) if you experience any problem to access the form.
- IELTSs English Language test scores on application. An average of 6.5 and no less than 6 in anyone of the four components. Applicant should have these results when applying.

Applications should be sent to STEM-EI-Research@open.ac.uk by 28 February 2019