TECHNISCHE UNIVERSITÄT DRESDEN

HZDR HELMHOLTZ ZENTRUM DRESDEN ROSSENDORF

Faculty of Mechanical Science & Engineering Institute of Process Eng. & Environmental Technology
Chair of Transport Processes at Interfaces

15 Oktober 2021

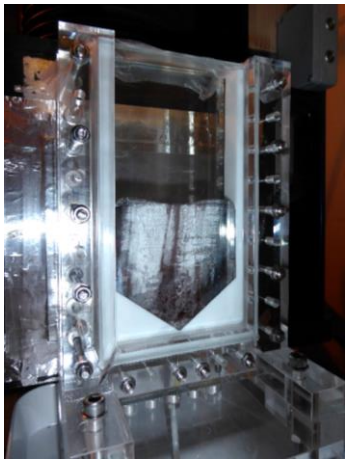
Internship / Student Assistant / Bachelor thesis / Master thesis / Diploma thesis

Rising drops in liquid metal: imaging measurements with neutrons and X-rays

Metallurgical processes are based on multi-phase flows in molten metals. Bubble injection via gas spargers plays an important role in metal purification, homogenisation as well as alloying. The principle of bubble flotation is of particular high impact in the aluminium and steel-making industries.

From the fluid dynamics view, liquid drops that are insoluble in a liquid metal show many similarities with gas bubbles. Both, drops and bubbles, may change their shape dynamically, collide with each other, and merge or split up by reducing or enlarging the interfacial area. Although liquid and gaseous phases are different in terms of density, interfacial tension or viscosity, dimensionless quantities such as Eötvös, Morton and Reynolds numbers allow comparing the characteristics of drops and bubbles in liquid metals, thus drawing conclusions on bubble flows in metallurgical processing.

In order to visualise rising drops in an optically opaque liquid metal, we have recently performed neutron radiographic measurements at the NEUTRA beamline of the Swiss spallation neutron source (SINQ), Paul Scherrer Institute, Switzerland. The neutron image sequences acquired at high temporal resolution give a unique insight into the motion of ascending drops in a low-melting gallium metal alloy.

(a) 

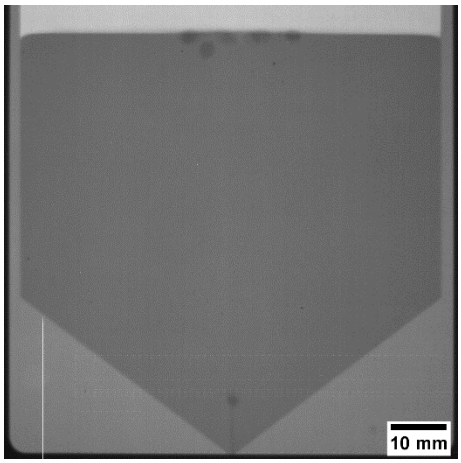
(b) 

Fig. Neutronradiographic measurement of rising drops in a low-melting gallium alloy: **(a)** measurement cell filled with the liquid metal, **(b)** single frame from a neutron image sequence.

The student research project offered here is mainly concerned with image processing and analysis of the acquired neutron image data. In addition, we intend to perform supplementary X-ray radiographic measurements with the same experimental setup in our X-ray laboratory at HZDR. From the neutron and X-ray images, we aim to reveal the size and shape of drops along their motion paths while ascending in the liquid metal. Using the above-mentioned dimensionless quantities, we then can compare the characteristics of these drops with bubbles observed in lab-scale experiments or applied in industrial-scale processes.

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Requirements

- field of study: chemical engineering, process engineering, fluid mechanics, or similar focus in chemistry or physics
- experience with data analysis, particularly image processing, e.g. with ImageJ or MATLAB
- experience with laboratory work and imaging measurement techniques is beneficial
- high motivation and interest in the subject
- careful, structured and independent way of working
- good oral and written communication skills in English or German
- enjoyment of scientific work

Conditions

- working in a multi-disciplinary and international team
- place of work: HZDR
- start: from December 2021
- duration: min. 3 month
- remuneration according to HZDR internal regulations

Contact

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