

Fluids and Space Engineering Seminar

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Location: ZARM, Room 1730

Influence of interface dynamics on mass transfer and chemical reaction

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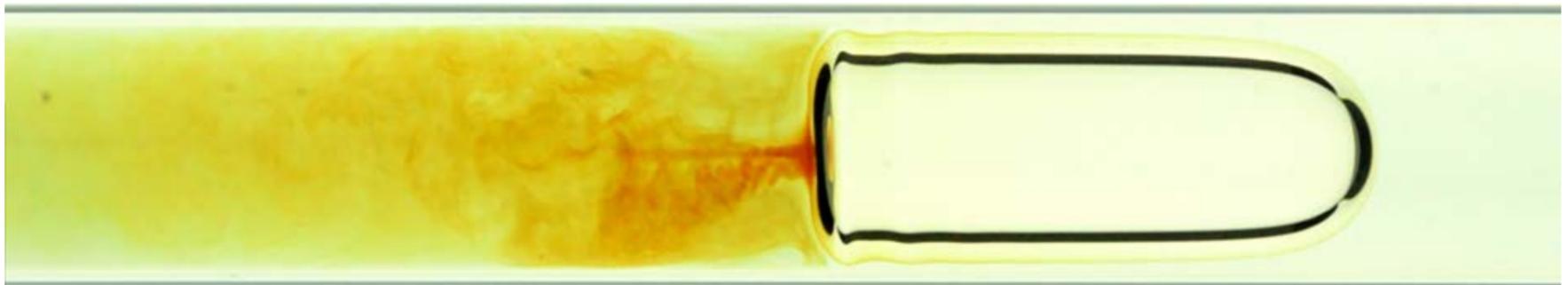


Figure 1: Oxygen Taylor-Bubble reacting in a Cu(btmgp)I – acetonitrile solution

Fast gas-liquid reactions are often performed in bubbly flows to provide an intensive mixing with high heat and mass transfer performance. In such flows, the gaseous reactants have to be transferred across the interface, through the hydrodynamic boundary layer into the liquid bulk phase that is dominated by bubble wakes and other turbulent structures. The pathway of reactants and its residence time within the boundary layer and the bubble wake is strongly dominated by the unsteady moving interface of the bubble and difficult to predict. Common theories like the penetration theory or the two-layer theory are underlying strong assumptions and their application to reactive bubbly flows is therefore questionable. New insights into interface dynamics are necessary to understand their impact on mass transfer as well as yield and selectivity of fast chemical reactions. To study local flow structures and concentration fields in detail, the Time Resolved Scanning Technique has been used in combination with Particle Image Velocimetry and Laser Induced Fluorescence. This method enables the measurement of the three-dimensional flow structures in the vicinity of a free rising bubble and its influence on the hydrodynamics and mass transfer performance of a trailing bubble. The three-dimensional concentration field, e.g. for oxygen as transferred species, can be determined additionally to study in detail how the local mass transfer performance is influenced by the vortices induced by other bubbles. Furthermore, the influence of such effects on gas-liquid reactions can be determined. This lecture will answer the question how significantly mass transfer and chemical reactions are influenced by interface dynamics in reactive bubbly flows.