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Review Article

MASS TRANSFER ON NUCLEATE BOILING: A REVIEW

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The subject of mass transfer studies the relative motion of some chemical species with respect to others (i.e., separation and mixing processes), driven by concentration gradients (really, an imbalance in chemical potential, as explained in Entropy). Fluid flow without mass transfer is not part of the Mass Transfer field but of Fluid Mechanics. Heat transfer and mass transfer are kinetic processes that may occur and be studied separately or jointly. Studying them apart is simpler, but it is most convenient (to optimize the effort) to realize that both processes are modeled by similar mathematical equations in the case of diffusion and convection (There is no mass-transfer similarity to heat radiation), and it is thus more efficient to consider them jointly. Some common examples of mass transfer processes are the evaporation of water from a pond to the atmosphere, the purification of blood in the kidneys and liver, and the distillation of alcohol. In industrial processes, mass transfer operations include separation of chemical components in distillation columns, absorbers such as scrubbers, absorbers such as activated carbon beds, and liquid-liquid extraction.

Keywords: Nusselt number, thermo-phoresis, Navier-Stokes, Convection, Péclet number

INTRODUCTION

Mass transfer is often coupled to additional transport processes, for instance in industrial cooling towers. These towers couple heat transfer to mass transfer by allowing hot water to flow in contact with hotter air and evaporate as it absorbs heat from the air. On the other hand, the subject of Mass Transfer is directly linked to Fluid Mechanics, where the single-component fluid-flow is studied, but the approach usually followed is more similar to that used in Heat Transfer, where fluid flow is mainly a boundary condition empirically modeled; thus, the teaching of Mass Transfer traditionally follows and builds upon that of Heat Transfer (and not upon Fluid Mechanics). In fact, development in mass-transfer theory closely follows that in heat transfer, with the pioneering works of Lewis and Whitman in heat transfer, mass transfer, and momentum transfer, are often jointly considered as a new discipline. As usual, the basic study first focuses on homogeneous non-reacting systems with

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well-defined boundaries (not only in Mass Transfer, but in Heat Transfer and in Fluid Mechanics), touching upon moving-boundary problems and reacting processes only afterwards. As for the other subjects, it is based on the continuum media theory, i.e., without accounting for the microscopic motion of the molecules (so that field theory and the fluid-particle concept are applied here too). Diffusion theory only applies to molecular mixtures (d<10-8 m); for colloids and suspensions (10-8.10-5 m), Brownian theory must be applied, and for larger particles (>10-5 m) Newtonian mechanics applies. Notice that we only consider here mass diffusion due to a concentration gradient, what might be called concentration-phoresis in analogy to other mechanisms of mass diffusion like thermo-phoresis (Soret effect), piezo-phoresis (diffusion due to a pressure gradient), or electrophoresis (diffusion due to a gradient of electrical potential applied to ionic media). There are notable similarities in the commonly used approximate differential equations for momentum, heat, and mass transfer.The molecular transfer equations of Newton's law for fluid momentum at low Reynolds number (Stokes flow), Fourier's law for heat, and Fick's law for mass are very similar, since they are all linear approximations to transport of conserved quantities in a flow field. At higher Reynolds number, the analogy between mass and heat transfer and momentum transfer becomes less useful due to the of the Navier-Stokes equation (or more fundamentally, the general momentum conservation equation, but the analogy between heat and mass transfer remains good. A great deal of effort has been devoted to developing analogies among these three transport processes so as to allow prediction of one from any of the others.

Figure 1: Active Size Range of Nucleation Site
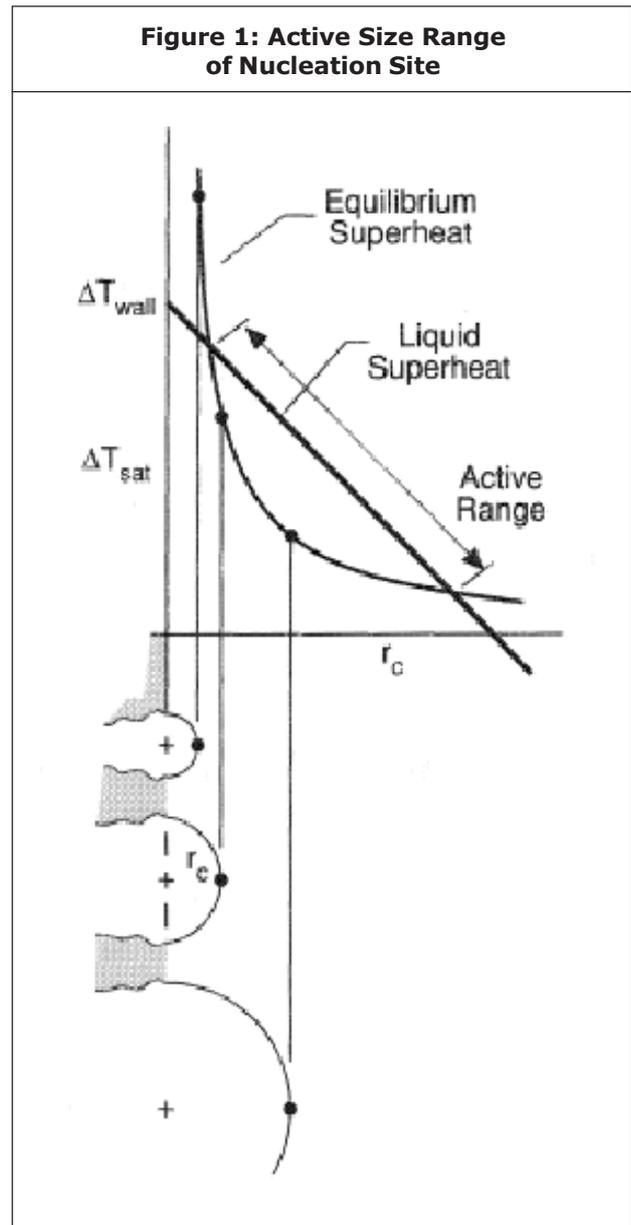
Chemical species are atoms, molecules, molecular fragments, ions, etc., subjected to a chemical process or to a measurement. Generally, a chemical species can be defined as an ensemble of chemically identical molecular entities that can explore the same set of molecular energy levels on a characteristic or delineated time scale. The term may be applied equally to a set of chemically identical atomic or molecular structural units in a solid array.

In supramolecular chemistry, chemical species are those supramolecular structures whose interactions and associations are brought about via intermolecular bonding and debonding actions, and function to form the basis of this branch of chemistry.
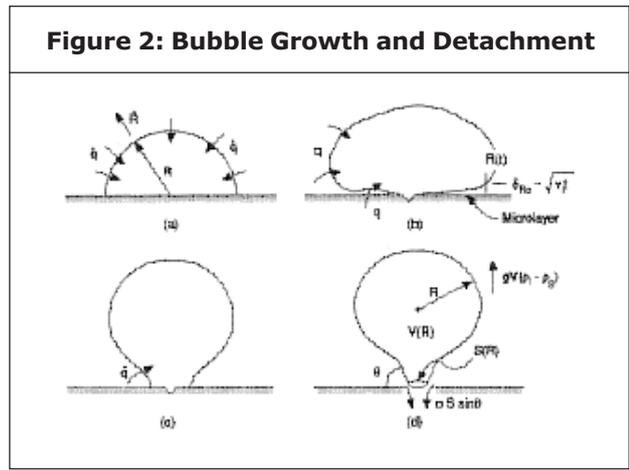
Figure 2: Bubble Growth and Detachment

Mass Transfer education traditionally follows and builds upon that of Heat Transfer because, on the one hand, mass diffusion due to a concentration gradient is analogous to thermal-energy diffusion due to a temperature gradient, and thus the mathematical modeling practically coincides, and there are many cases where mass diffusion is coupled to heat transfer (as in evaporative cooling and fractional distillation); on another hand, Heat Transfer is mathematically simpler and of wider engineering interest than Mass Transfer, what dictates the precedence. But there are important differences between both subjects. Radiation: First of all, from the three heat transfer modes (conduction, convection, and radiation), only the two first are considered in mass transfer (diffusion and convection), radiation of material particles (as neutrons and electrons) being studied apart (in Nuclear Physics). Notice, by the way, that the word diffusion can be applied to the spreading of energy (heat diffusion), or species (mass diffusion), or even momentum in

a fluid or electric charges in conductors, but the word conduction is more commonly used than heat diffusion (whereas mass conduction is rarely used). Solids versus fluids. Heat Transfer starts with, and focuses on, heat diffusion in solids, which have higher thermal conductivities than fluids, the latter being considered globally through empirical convective coefficients, whereas Mass Transfer focuses on gases and liquids, which have higher mass diffusivities than solids. The explanation for such a difference is that heat conduction propagates by particle contact (for the same type of particles, the shortest separation the better), whereas mass diffusion propagates by particles moving through the material medium (for the same type of particles, the largest voids the better). Moreover, Heat Transfer problems in solids are simple and relevant to many applications, whereas Mass Transfer problems in solids are of much lesser relevance, and Mass Transfer problems in fluids are much more complicated because the simplest mass-diffusion problems are of little practical interest, convection within fluids being the rule (fluids tend to flow). When diffusion in solids is wanted, as in doping silicon substrates in microelectronics, or in surface diffusion of carbon or nitrogen in steel hardening, high temperature operation is the rule (diffusion coefficients show an Arrhenius' type dependence with temperature). Slowness: Thermal diffusivities decrease from solids to fluids, with typical values of a $\sim10^{-4} m^2/s$ for metals and a $\sim10^{-5} m^2/s$ for non-metals, down to a $10^{-5} m^2/s$ for gases and a$\sim10^{-7} m^2/s$ for liquids. On the contrary, mass diffusivities decrease from fluids to solids, with typical values of Di$\sim10^{-5} m^2/s$ for gases and Di$\sim10^{-9} m^2/s$ for liquids, down to Di$\sim10^{-12} m^2/s$ for solids Bulk flow. There is no bulk flow in heat diffusion (either within solids or fluids),

whereas there is always some bulk flow associated to diffusion of species (except in the rare event of counter diffusion of similar species); i.e., mass diffusion generates mass convection, in general. Number of field variables: One may consider just one heat-transfer function, the temperature field T (the heat flux is basically the gradient field), but several mass-transfer functions must be considered, one mass fraction, yi, for each species i=1..C (C being the number of distinct chemical species), although most problems are modeled as a binary system of just one species of interest diffusing in a background mixture of averaged properties. Continuity at interfaces Mass-transfer boundary conditions at interfaces are more complex than thermal boundary conditions, because there are always concentration discontinuities, contrary to the continuous temperature dictated by local equilibrium (chemical potentials are continuous at an interface, not concentrations). Diffusion 'uphill': Besides the effect of coupled fluxes, it is important to realise that mass diffusion can be from a low concentration within a condensed medium towards a high concentration within a more disperse medium, because, as said, it is not concentration-gradient but chemical-potential-gradient, what drives mass diffusion.

Applications

Applications of Mass Transfer include the dispersion of contaminants, drying and humidifying, segregation and doping in materials, vaporization and condensation in a mixture, evaporation (boiling of a pure substance is not mass transfer), combustion and most other chemical processes, cooling towers, sorption at an interface (adsorption) or in a bulk (absorption), and most living-matter processes as respiration (in the lungs and at cell level), nutrition, secretion, sweating, etc. A common process to separate a gas from a gaseous mixture is to selectively dissolve it in an appropriate liquid (this way, carbon dioxide from exhaust gases can be trapped in aqueous lime solutions, and hydrogen sulfide is absorbed from natural-gas sources; when water vapor is removed, the absorption process is called drying. Stripping is the reverse of absorption, i.e., the removal of dissolved components in a liquid mixture. Distillation is the most important separation technique.

Problem Description

From the study of literature we are going to investigate the mass transfer by the convective mass transfer in the boiling processes initially, the container contains water (the primary phase) at a temperature near the boiling point (372 K). The center portion of the bottom wall of the container is at a temperature of 573 K, which is higher than the boiling temperature. Because of conduction, the temperature of the liquid near this wall will increase beyond the saturation temperature (373 K). Vapor bubbles will form and rise due to buoyancy, establishing a pattern similar to a bubble column with vapor escaping at the top and water re-circulating in the container. This we are validating through CFD software Fluent or CFX, etc., this will gives us the comparative liquid velocity magnitude, vapor volume fraction and temperature.

OBJECTIVE OF WORK

The dissertation is carried out on the mass transfer to understand the principal and the effect of the boundary condition of the system for the mass transfer in the boiling. Outcome in the study are Liquid velocity magnitude, vapor volume fraction, Static pressure and temperature.

LITERATURE REVIEW

Shen *et al.* (2014) have studied Mass transfer of dissolved oxygen using rotating cylinder electrode under bulk boiling conditions.

The mass transfer behavior of oxygen and ferricyanide in dilute aqueous solutions was investigated using a rotating cylinder electrode under bulk boiling condition. A correlation was developed for predicting the mass transfer behavior using the reaction of dissolved oxygen below boiling condition. This correlation was used to predict the mass transfer behavior for ferricyanide reaction from room temperature to just below boiling point (i.e., 99°C) for the rotating speeds between 100 and 3300 rpm. These results indicated that the ferricyanide reaction could be used as a model to predict the electrochemical behavior of dissolved oxygen at the elevated electrolyte temperatures. However, the correlation could not predict the experimental data obtained under boiling conditions very well. The experimentally determined mass transfer coefficients under boiling condition were on the average 38% higher than those obtained just below boiling point due to the generation and rupture of boiling bubbles in bulk solution.

Musharafa Saleem and Aun Haider (2014) studied about heat and mass transfer on the peristaltic transport of non-Newtonian fluid with creeping flow.

A new mathematical model has been developed for the peristaltic transport of Maxwell fluid with heat and mass transfer, while taking into account the effect of thermal diffusion (Soret), occurring in an asymmetric channel with creeping flow. The inertia terms are omitted from the equations of motion, which leads to solutions that approximately valid for low Reynolds number, i.e.,

$Re \square 1$. The walls are kept at different but constant temperatures and concentrations. A perturbation solution is acquired, which satisfies the momentum, energy and concentration equations for the case by choosing a small wave number. Numerical results are evaluated for pressure rise and frictional forces per wavelength. The velocity, temperature and concentration fields have been appraised for diverse values of the parameters entering into the problem. The influence of diverse parameters of interest on pumping, trapping, temperature and concentration profiles has been investigated graphically.

Serrano-Arellano and Gijón-Rivera (2014) studied Conjugate heat and mass transfer by natural convection in a square cavity filled with a mixture of Air–CO_2.

A numerical study of conjugated heat (natural convection–thermal radiation) and mass transfer in a square cavity filled with a mixture of Air–CO_2 is presented. The study was performed through laminar and turbulent regimes ($104 \square Ra \square 1010$). The cavity is differentially heated with two isothermal walls and two adiabatic. The hot wall is kept at a constant temperature of 75°C with a CO_2 concentration of 3000 ppm, whereas the cold wall is considered to be an isothermal wall at 25°C with a CO_2 concentration of 500 ppm. Governing equations of mass, energy and concentration were solved by the finite volume method, and a k–ε turbulence model was used for the treatment of high Rayleigh numbers. From the results, it was found that in general, convection and total heat transfer amount increases considerably as the mass transfer is taking into account, but it decreases as the Rayleigh number increases. Similarly, it was observed that the radiative heat transfer decreases the heat transfer by convection but increases the total heat

transfer inside the cavity, especially for high Rayleigh numbers.

Amina Meslem *et al.* (2013), studied flow dynamics and mass transfer in impinging circular jet at low Reynolds number. Comparison of convergent and orifice nozzles**.**

Electro diffusion and Particle Image Velocimetry (PIV) measurements were made in two impinging jets, the first exiting from a convergent nozzle and the second from a square-edged orifice nozzle having same exit diameter. The Reynolds number, based on nozzle diameter and exit bulk-velocity, was equal to 1360 in each flow. The wall-shear rate and mass transfer generated by orifice impinging jet on a flat plate are up to 42% and 18%, respectively higher than in its counterpart convergent nozzle jet. The transfer feature on the impingement surface has a close relationship with near field flow dynamics, itself affected by flow conditions at the nozzle exit. The orifice jet flow generates larger in size, well-defined and vigorous primary Kelvin–Helmholtz (K–H) structures with comparison to the convergent nozzle jet. These differences were associated with differences in initial velocity profiles and in the resulting flow development. The *vena contracta* in the orifice jet generates a thinner shear layer and an increase of the exit mean velocity relative to exit bulk-velocity. Organized structures in the two flows are reduced using DMD and POD applied to PIV measurements. The dominant frequency of each flow related to the K–H instability, captured using DMD analysis of PIV fields, is also obtained by studying energy spectra of electrodiffusion signals. A quantitative measure of the Kinetic Energy (KE) distribution in different POD modes reveals that for reconstruction of 80% of the total KE, 7 modes are required for the orifice impinging

jet and 42 modes for the convergent impinging jet. This comparison confirms the larger degree of flow organization in orifice jet before impinging on the target wall and explains its performance in the resulting mass transfer on the wall surface.

Jordi Pallares and Francesc Xavier Grau (2014) studied mass transfer rate of a first-order chemical reaction on a wall at high Schmidt numbers. In this study, we propose a simple formula to calculate the steady-state surface averaged Sherwood number at high Schmidt numbers when a first-order chemical reaction occurs on a wall. The formula uses the surface averaged Sherwood number corresponding to the mass transfer rate with an infinitely fast kinetic and the Damkhöler number. The validity of the prediction is analyzed. It has been found that it predicts the surface averaged Sherwood number of the analytical solution within 5% for wide ranges of Reynolds and Damkhöler numbers. The mathematical form of the prediction is suitable to compute the initial transient of the time evolution of the surface averaged Sherwood number in unsteady state conditions. The validity of this time evolution is determined by comparing it with numerical simulations.

Mingchun Li *et al.* (2013) studied effect of endothermic reaction mechanisms on the coupled heat and mass transfers in a porous packed bed with Soret and Dufour effects. Taking the influences of chemical reaction mechanisms into account, a mathematical model has been developed to simulate the coupled heat and mass transfer as well as endothermic reactions in a non-thermal equilibrium packed bed with Soret and Dufour effects, which was numerically solved and validated by comparing with experimental data. It was found that the chemical reaction mechanisms have a great influence on the

calculated solutions, and the cross-diffusion effects on the reactive characteristics of the packed beds are diverse under different chemical reaction mechanism. For the heat transfer controlled mechanism, the maximum reductions of the concentration of gas product and the solid fractional conversion induced by the Soret and Dufour effects are 25.1% and 14.4%, respectively at superficial velocity 53.3 cm^{-1} and the Nusselt number 4.1. However for the mass transfer controlled model, the calculated solid fractional conversions are higher than that obtained by neglecting the cross-diffusion effects and the increase being less than 16% at superficial velocity 11.9 cm^{-1} and the Sherwood number 47.1. The differences induced by the Soret and Dufour effects are demonstrated numerically to increase gradually with the Nusselt number or the Sherwood number.

Maria Valeria De Bonis and Gianpaolo Ruocco (2014) studied conjugate heat and mass transfer by jet impingement over a moist protrusion. Biosubstrates drying can be intensified, controlled and optimized, even in blunt shapes, by providing exposure to air jet impingement. In this paper round air jet impingement on cylinder protrusions of a model substrate is investigated, for moderate Reynolds numbers and various geometry arrangements.

A comprehensive numerical model, featuring conjugate interface transport (local fluid dynamic effects), multiphase coupling (local surface evaporation) and moisture diffusion notations, is first validated with the corresponding experimental results. Then quantitative distributions of temperature and moisture within the protrusion and along its exposed surface are presented, focussing on the dependence of surface heat and mass transfer on geometry arrangement and fluid

dynamic regime. Two values of Reynolds number, two jet heights and two protrusion/jet diameter ratio combinations are investigated.

It is pointed out that, within the investigated range of variables, a protrusion/jet diameter ratio equal to 1 allows for flow patterns that foster process enhancement, but at the expenses of treatment uniformity: after 15 min of treatment the 10% of protrusion only is still relatively moist, but with a strong internal non-uniformity, whereas with a protrusion/jet diameter ratio equal to 3 the untreated part accounts to the 85%, with a smoother internal distribution.

Gianfranco Caruso and Damiano Vitale Di Maio (2014) studied heat and mass transfer analogy applied to condensation in the presence of noncondensable gases inside inclined tubes. A theoretical and experimental investigation on steam condensation in presence of non-condensable gases within horizontal and inclined tubes is summarized in the present paper. A simple correlation mainly based on dimensionless numbers was derived and compared with previous formulations based on the diffusion layer model. The noncondensable gases presence during condensation is an important issue affecting the whole thermodynamic efficiency of the process, and for this reason highly investigated by many researchers. The experimental data obtained for condensation, inside horizontal or inclined tube (15°, 30° and 45°) with an internal diameter of 22 mm, of an air/steam mixture, at low mixture Reynolds numbers (<6000), have been used to verify the present Heat and Mass Transfer Analogy (HMTA) formulation. In order to perform the heat and mass transfer analogy, the suction effect at the interface has been taken into account since it considerably affects temperature and

concentration profiles and hence the transfer coefficients. The model of Chato is used for the condensate boundary layer since it has been identified to be the better model under the experimental condition. Finally, the experimental data have been compared with the theoretical Couette flow model with transpiration showing a quite good agreement.

Shuangchen Ma *et al.* (2013) studied research on mass transfer of CO_2 absorption using ammonia solution in spray tower. Research on mass transfer of carbon capture process plays an important role in the design of absorbing device. The effects of ammonia concentration, L/G, gas flow rate, gas temperature, CO_2 partial pressure and other factors on the volumetric overall mass transfer coefficient (*KGaV*), the gas phase mass transfer coefficient (*kG*) and the effective mass transfer cross-sectional area (*aV*) were investigated with ammonia solution as the absorbent in homemade spray tower. Experimental results show that *KGaV* has upward trend with the increasing ammonia concentration, L/G and gas flow rate, and first increases and then decreases with the rises of CO_2 partial pressure and gas temperature; *kG* increases with the increasing L/G, gas flow rate and CO_2 partial pressure; *aV* increases with the increasing ammonia solution and gas flow rates; CO_2 partial pressure has less impact on *KGaV*, *kG* and *aV*. Under the experimental conditions, maximums of *KGaV*, *kG* and *aV* are 0.17 kmolm^{-3}h^{-1}kPa^{-1}; 0.0022 kmolkPam^{-2}h^{-1} and 99.25 m^{2}m^{-3} respectively.

Shogo Hosoda *et al.* (2014), studied mass transfer from a bubble in a vertical pipe. Mass transfer from single carbon dioxide bubbles in vertical pipes is measured using a stereoscopic image processing method to develop a mass transfer correlation applicable to a wide range of bubble diameters in standard pipe sizes. The diameters of pipes used are 12.5, 18.2, and 25.0 mm and the bubble diameter ranges from 5 to 26 mm. The ratio, λ, of the bubble diameter to the pipe diameter is varied from 0.2 to 1.8, which covers various bubble shapes such as spheroidal, wobbling, cap, and Taylor bubbles. Measured Sherwood numbers, *Sh*, strongly depend on bubble shape, i.e., *Sh* of Taylor bubbles differs from that of spheroidal and wobbling bubbles. The Sherwood numbers are correlated in terms of the Peclet number *Pe* and λ. The applicability of the proposed correlation to long-term bubble dissolution process is examined through comparisons between measured and predicted dissolution processes. The predictions are carried out by solving mass conservation equations not only for carbon dioxide but also for nitrogen and oxygen. Good agreements are obtained in the dissolution processes for various bubble sizes and the three pipe diameters.

Christoph Albert *et al.* (2014) studied direct Numerical Simulation of interfacial mass transfer into falling films. This contribution is concerned with interfacial mass transfer into falling films, for which detailed insight is achieved by means of Direct Numerical Simulation employing the Volume-of-Fluid method. As for the numerical model for mass transfer across the fluid interface of falling films, we employ the two-scalar approach.

We examine the influence of wave regimes and flow patterns on local Sherwood numbers and identify distinct mass transfer enhancement mechanisms taking effect in specific wave regimes.

Guiraud Mass (or heat) transfer inside a spherical gas bubble rising through a stationary

liquid is investigated by direct numerical simulation. Simulations were carried out for bubble Reynolds number ranging from 0.1 to 100 and for Péclet numbers ranging from 1 to 2000. The study focuses on the effect of the bubble Reynolds number on both the interfacial transfer and the saturation time of the concentration inside the bubble. We show that the maximum velocity *U max* at the bubble interface is the pertinent velocity to describe both internal and external transfers. The corresponding Sherwood (or Nusselt) numbers and the saturation time can be described by a sigmoid function depending on the Péclet number *Pemax=Umaxdb/D* (*db* and *D* being the bubble diameter and the corresponding diffusion coefficient).

Minlin Yang To improve the performances of a Hollow Fiber Membrane Contactor (HFMC) employed for liquid desiccant air dehumidification, an Elliptical Hollow Fiber Membrane Contactor (EHFMC) is proposed. The contactor is assembled by a collection of elliptical hollow fibers populated in a shell. The liquid desiccant and the processing air streams flow inside and across the elliptical fibers, respectively. They are in a cross-flow configuration. The momentum and the conjugate heat and mass transports in the EHFMC are investigated based on Happel's free surface model. In this approach, a single elliptical fiber, an air stream across the fiber, and a liquid desiccant stream inside the fiber are selected as the calculating element. The air stream in the element is encompassed by a hypothetical outer free surface with an elliptical shape. The equations governing the momentum, heat and mass transports in the air and the solution streams are established and solved together with the conjugate heat and mass transfer boundary conditions. The fundamental data of the friction factor, Nusselt and Sherwood numbers in the element are then numerically calculated, experimentally validated, and analyzed. These basic data are compared with those obtained in the HFMC.

Bisang A continuous reduction in the cross-section area is analysed as a means of improving mass-transfer in a parallel-plate electrochemical reactor. Experimental local mass-transfer coefficients along the electrode length are reported for different values of the convergent ratio and Reynolds numbers, using the reduction of ferricyanide as a test reaction. The Reynolds numbers evaluated at the reactor inlet range from 85 to 4600 with interelectrode gaps of 2 and 4 mm. The convergent flow improves the mean mass-transfer coefficient by 10-60% and mass-transfer distribution under laminar flow conditions becomes more uniform. The experimental data under laminar flow conditions are compared with theoretical calculations obtained by a computational fluid dynamics software and also with an analytical simplified model. A suitable agreement is observed between both theoretical treatments and with the experimental results. The pressure drop across the reactor is reported and compared with theoretical predictions.

Jiwei Zhu Mass transfer coefficient is an important parameter in the process of mass transfer. It can reflect the degree of enhancement of mass transfer process in liquid-solid reaction and in non-reactive systems like dissolution and leaching, and further verify the issues by experiments in the reaction process. In the present paper, a new computational model quantitatively solving ultrasonic enhancement on mass transfer coefficient in liquid-solid reaction is established, and the mass transfer coefficient on silicon surface with a transducer at frequencies

of 40 kHz, 60 kHz, 80 kHz and 100 kHz has been numerically simulated. The simulation results indicate that mass transfer coefficient increases with the increasing of ultrasound power, and the maximum value of mass transfer coefficient is 1.467×10^{-4} m/s at 60 kHz and the minimum is 1.310×10^{-4} m/s at 80 kHz in the condition when ultrasound power is 50 W (the mass transfer coefficient is 2.384×10^{-5} m/s without ultrasound). The extrinsic factors such as temperature and transducer diameter and distance between reactor and ultrasound source also influence the mass transfer coefficient on silicon surface. Mass transfer coefficient increases with the increasing temperature, with the decreasing distance between silicon and central position, with the decreasing of transducer diameter, and with the decreasing of distance between reactor and ultrasound source at the same ultrasonic power and frequency. The simulation results indicate that the computational model can quantitatively solve the ultrasonic enhancement on mass transfer coefficient.

Paitoon Tontiwachwuthikul The mass transfer performance of CO_2 absorption into three solvents (i.e., 5 M MEA in methanol, 5 M MEA in 1:1 water-methanol volume ratio, and 5 M MEA aqueous solutions) in an absorption column packed with DX structured packing at various CO_2 loading, liquid flow rate, and inert gas flow rate. The mass transfer performance was evaluated in terms of volumetric overall mass transfer coefficient (KGav) and mass flux. The results showed that 5 M MEA in methanol has higher mass transfer performance than those of 5 M MEA in 1:1 water-methanol volume ratio and 5M MEA aqueous solutions, respectively. In addition, CO_2 loading and liquid flow rate had significant effect on mass transfer performance, but inert gas flow rate has insignificant effect on mass transfer performance.

Outcome of the Work

- Liquid velocity magnitude
- Vapor volume fraction
- Static pressure
- Temperature

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