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CFD Simulation and Experimental Validation of the Bubble-Induced Flow during Electrochemical Water Splitting

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Abstract : The bubble formation during hydrogen production by electrolysis and several electrochemical processes is an inherent phenomenon and can impact the energy consumption of the processes. In this work, it was reported both experimental and computational results describe the effect of bubble displacement, which, under the cases investigated, leads to the formation of a convective flow in the solution. The process is self-sustained, and a solution vortex is formed, which modifies the bubble growth and covering at the electrode surface. Using the experimental data, we have built a model to simulate it, which, with high accuracy, describes the phenomena. Then, it simulated many different experimental conditions and evaluated the effects of the boundary conditions on the bubble surface covering the surface. We have observed a position-dependent bubble covering the surface, which has an effect on the water-splitting efficiency. It was shown that the bubble covering is not uniform at the electrode surface, and using statistical analysis; it was possible to evaluate the influence of the gas type (H2 and O2), current density, and the bubble size (and cross-effects) on the covering fraction and the asymmetric behavior over the electrode surface.

Keywords : water splitting, bubble, electrolysis, hydrogen production
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