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A 3D ENRICHED-FEM / LEVEL-SET FRAMEWORK FOR SIMULATING DROPLET DYNAMICS WITH CONTACT-ANGLE HYSTERESIS

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ABSTRACT

Successful modeling of the droplet dynamics in contact with a solid substrate requires the effective incorporation of the phenomena associated with the wetting dynamics [1]. Beside the dissipation associated with the contact-line dynamics, which can be modeled by a combination of the molecular kinetic and the hydrodynamic theories [2], contact-angle hysteresis [3] play a significant role. Hysteresis characterized by differentiating the advancing and receding contact-angles, can be incorporated into the model as a pinning mechanism for the contact-line.

In this work, various requirements for developing a numerical model for simulating droplet dynamics are addressed within the framework of the enriched finite element / level-set approach [4]. The presented framework, developed at the continuum level, provides an efficient means to three-dimensional simulations of the liquid-gas flow. Here, the main focus is on the inclusion of the contact-angle hysteresis. Within the scope of the present work, the proposed method is applied to the droplet dynamics analysis in the gas channel of a PEM fuel cell.

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