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Direct Numerical Simulation of electrochemical reactions in a turbulent electrolyte[1] OLIVIER DOCHE, FREDERIC BAUER, LEPMI - Grenoble Univ., SEDAT TARDU, LEGI - Grenoble University — In electrochemical processes, such as industrial electrodeposition, the flow state can influence the mass transfer of the active chemical species in solution. This could lead to significant modifications of reaction kinetics at the electrode and obviously affects the global performance of the system. We aim here to describe via DNS the behavior of a turbulent electrolyte in a channel configuration where electrode are placed at each wall. Since the whole problem is governed by a full multiphysic coupling, we resolve in 3D and at each time step a set of equations constituted by 2 turbulent transport equations -momentum and a passive scalar- completed by the potential distribution resolution. These 3 distinct physics are coupled through the Butler-Volmer boundary condition which acts at the electrode/electrolyte interface and governs the whole electrochemical activity. We present the numerical methodology used in this work and all the quantitative results obtained. We also report significant differences with the literature, mainly on the mass transfer statistics, which tend to confirm that a fully coupled approach is necessary to obtain a reliable description of the physic involved in such electrochemical transformations.

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