אמרי אטלס

התכנית הבין-יחידתית לאנרגיה

בנושא:

Periodic Energy Conversion in Electric-Double-Layer Capacitor (EDLC)-Based Transducer

Electrostatic conversion devices operate through modulation of capacitance. Such devices have a wide range of configurations, mostly involving either changes in permittivity, electrode-plate spacing or wetting area. The presented study examines, theoretically, an Electric-double-layer capacitor (EDLC)-based transducer, as it converts periodic salt and heat fluxes into an electric alternating current. In general, a constant voltage applied at EDLC electrodes forms two opposite sign diffusive EDL's. An electric current is generated when ionic charges pass from one EDL to the other. In the examined configuration, this ionic charge transfer is induced by boundary modulation of either an electrically-neutral ion flux or temperature. To capture the oscillating dynamics of the ion distribution and ion flux, we solve the full set of Poisson-Nernst-Planck equations coupled with the energy equation, with the appropriate oscillating boundary conditions. We find that the transducer's optimal performance conditions, attaining the maximal current density amplitude, is governed by two main factors: confined geometry, where the capacitor thickness is on the order of the EDL's characteristic Debye screening length and resonance frequency dictated by characteristic mass and heat diffusion times.

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