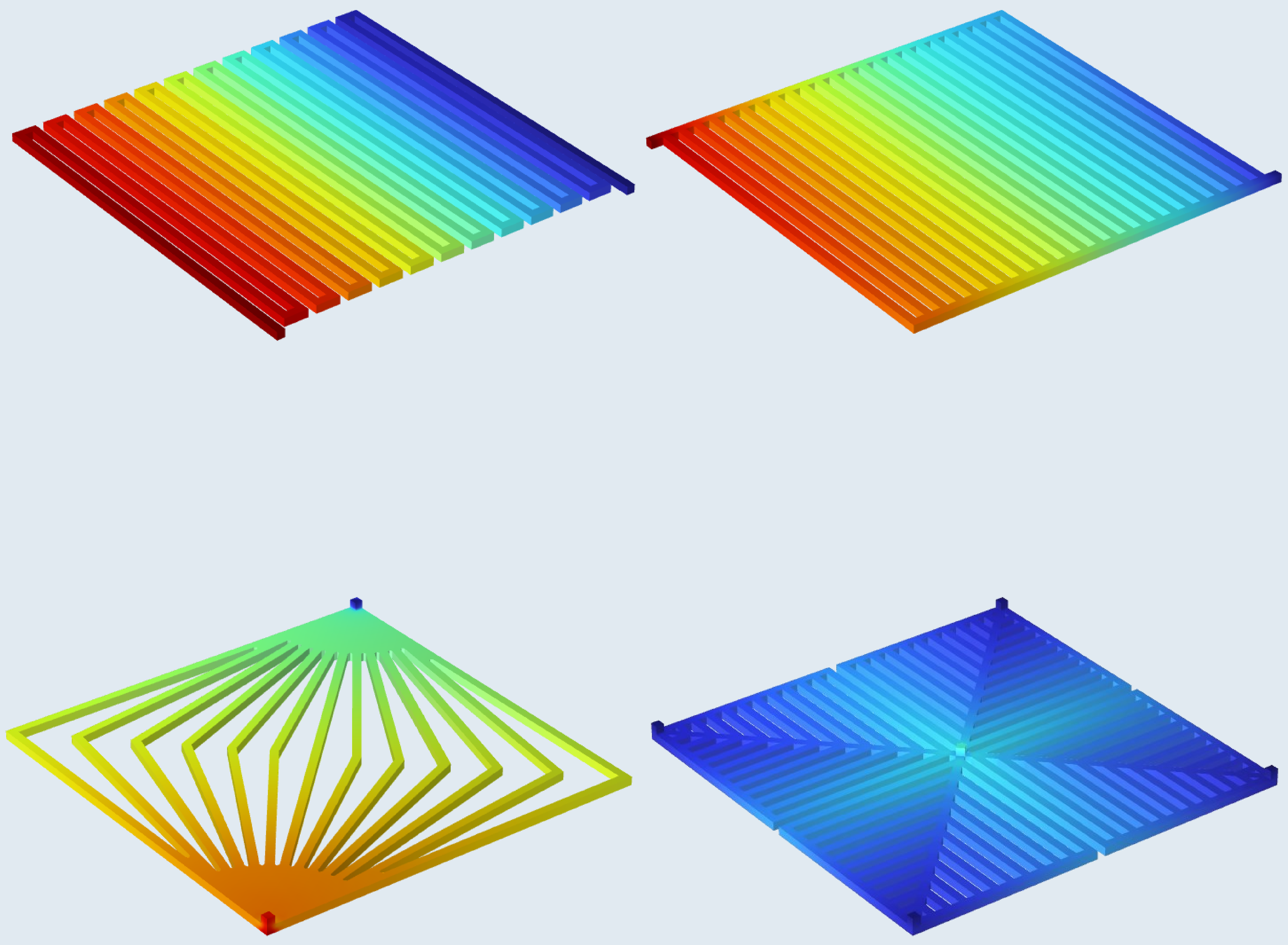

Bio-Inspired Flow Fields Designed for Solid Oxide Electrolysis Cell

This study focuses on designing biomimetic leaf-like flow fields for co-electrolysis in solid oxide electrolysis cell. The goal is to enhance overall performance in energy conversion processes.

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Abstract

The flow field structure in solid oxide electrolysis cell (SOEC) directly affects the distribution of reactants, thereby influencing the reaction rate and temperature distribution. A well-designed flow channel is beneficial for enhancing the electrochemical performance and operational stability of the SOEC.

To enhance the performance of SOEC, two biomimetic flow fields are designed based on the vein structures of ginkgo and clover leaves in this study.

A three-dimensional SOEC model is developed using COMSOL to investigate the impact of flow fields on the performance of the SOEC.

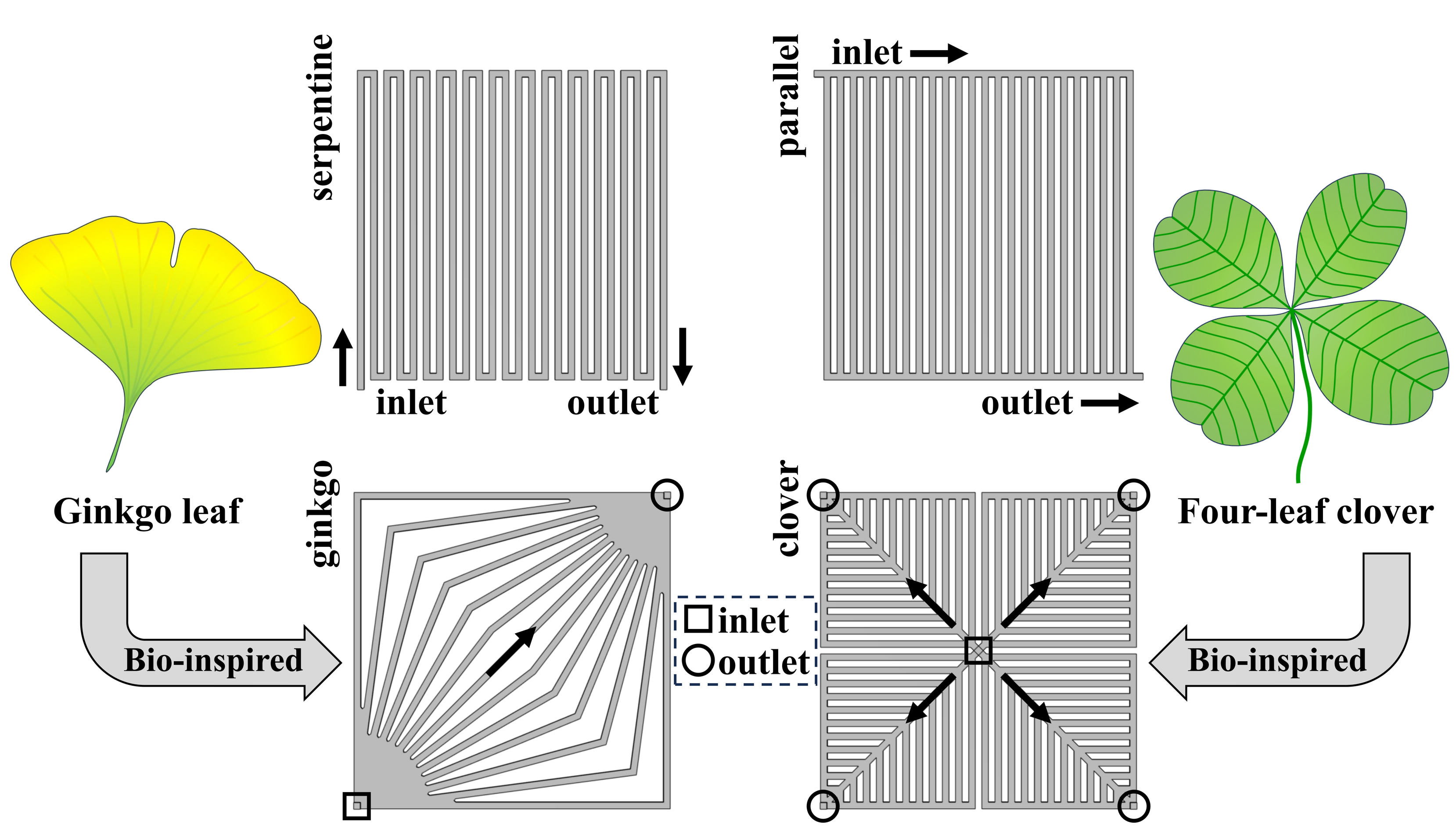

FIGURE 1. The geometry of four kinds of flow fields.

Methodology

The computational domain consists of four parts: cathode/anode interconnects, cathode/anode channels, cathode/anode electrodes and electrolyte.

The mathematical model of the SOEC mainly consists of electrochemical model, chemical model, and several conservation equations.

Results

Under the same operating conditions, the performance of the electrolysis cells is as follows: clover > ginkgo > parallel > serpentine. Biomimetic flow fields have the potential to reduce the operating voltage of SOEC at high current densities, which could help promote the practical application of SOEC.

Applying suitable biomimetic flow fields can improve the uniformity of physical field distribution, which helps to fully utilize the active electrode areas. At the same time, it prevents significant differences in current and voltage distribution within the electrodes, contributing to the stable operation of SOEC.

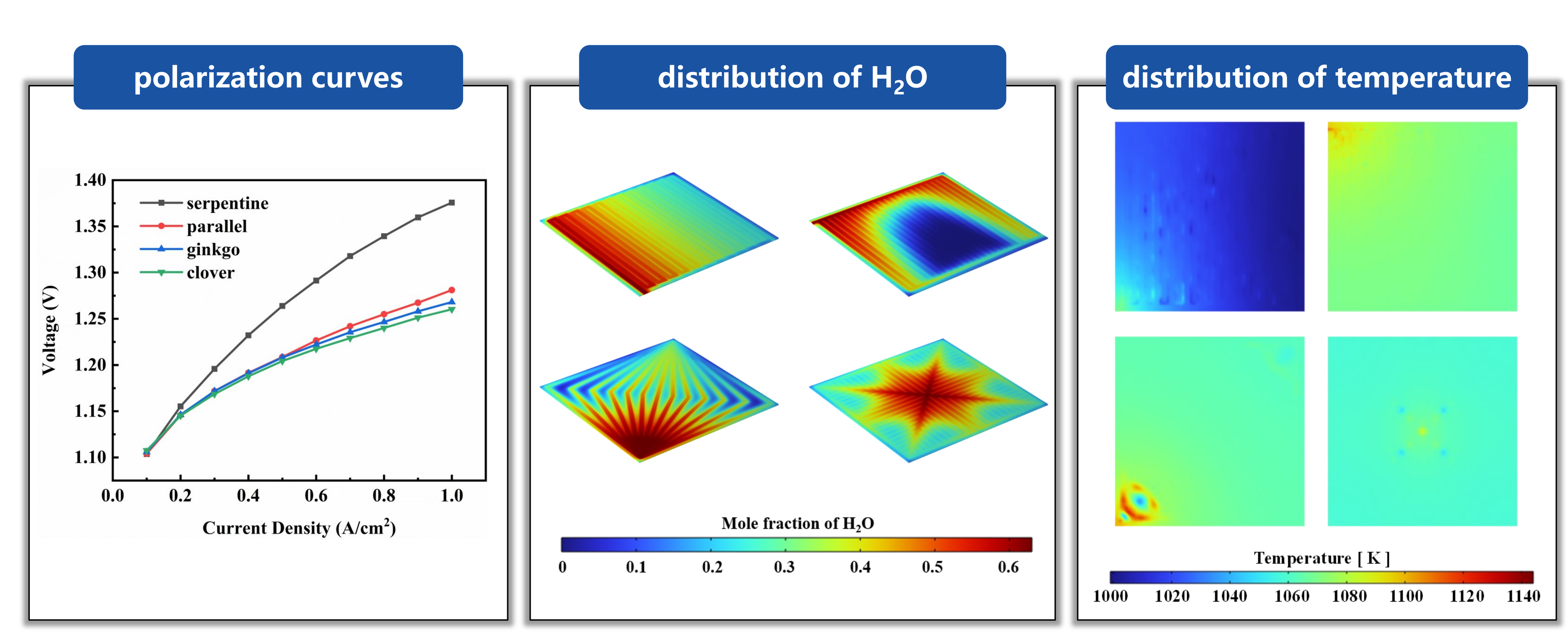

FIGURE 2. Simulation results of polarization curves and the distribution of physical fields.

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