**Code Manual of Dendrite Growth for Hybrid-Ion Batteries (DenGrowth4HIB)**

**2024-7**

**Steps to obtain the simulation results of the dendritic morphology**

1. **Download Package**

Download the DenGrowth4HIB package from the following URL: <https://github.com/IR-LFSCL/DenGrowth4HIB>. Extract the package to obtain the Dendrite Growth folder.

1. **File Description**

The Dendrite Growth folder contains two subfolders (Atlas and Data) and ten MATLAB (.m) files:

* Atlas: Stores generated images.
* Data: Stores calculation data at specified time points.

The MATLAB files included are:

* Den\_Matrix2.m: The main program.
* Commands.m: The auxiliary program that generates images from the calculation data and stores them in the Atlas folder.
* DensityPlot.m: The plotting function.
* DivG.m: The function for calculating the divergence of gradients.
* DotG.m: The function for calculating the dot product of two gradients.
* Dx.m: The function for calculating the derivative in the x-direction.
* Dy.m: The function for calculating the derivative in the y-direction.
* EllSol.m: The function for solving the ellipse equation.
* OutputData.m: The function for outputting calculation data.
* OutputFig.m: The function for outputting an image of a field variable, which is called by Commands.m.

1. **Hardware and Software Requirements**

Hardware Requirements:

* Processor: Intel or AMD dual-core with a main frequency above 1GHz.
* Memory: 4GB or more.

Software Requirements:

* Operating System: Windows 7 or later.
* MATLAB 2020a or later.

1. **Running Codes**

* Open MATLAB software.
* In MATLAB, navigate to the Dendrite Growth folder and open the main program Den\_Matrix2.m.
* Run Den\_Matrix2.m. During the execution, calculation data at specified time points will be written into the Data folder.
* Once the calculations are complete and all specified time point data have been output, open and run the auxiliary program Commands.m. This will generate images from all calculation data and store them in ‘Atlas’ folder.

1. **Results**

By running the program as described, the Zn dendritic morphology for a Na:Zn ratio of 3:7 will be obtained. To obtain the Zn dendritic morphology for other concentration ratios, adjust the Na and Zn concentration ratio accordingly and repeat the above steps.