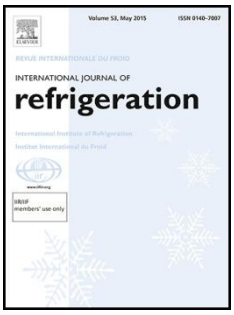
# Accepted Manuscript

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PII: S0140-7007(17)30046-4
DOI: http://dx.doi.org/doi: 10.1016/j.ijrefrig.2017.01.026
Reference: JIJR 3538

To appear in: *International Journal of Refrigeration*

Received date: 13-10-2016
Revised date: 12-12-2016
Accepted date: 24-1-2017

Please cite this article as: Teresa Benítez, S.A. Sherif, Modeling Spatial and Temporal Frost Formation with Distributed Properties on a Flat Plate using the Orthogonal Collocation Method, *International Journal of Refrigeration* (2017), http://dx.doi.org/doi: 10.1016/j.ijrefrig.2017.01.026.

# Modeling Spatial and Temporal Frost Formation with Distributed Properties on a Flat Plate using the Orthogonal Collocation Method

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Highlights

- Orthogonal collocation is used to solve the equations describing frost formation.
- Front-fixing method used to handle moving boundary.
- Supersaturation at the interface between gaseous and solid phases is incorporated.
- Frost properties are predicted as a function of position as well as time.

*Abstract*—In this paper the orthogonal collocation method is used to solve the equations that describe the frost formation process when a cold flat plate is exposed to a humid air stream. The proposed scheme combines a front-fixing method to handle the moving boundary with the orthogonal collocation method to discretize and solve the resulting set of partial differential equations. Time and spatial variations of frost properties such as porosity and density as well as other relevant variables such as the frost thickness, frost temperature, and heat flux through the frost layer—are predicted with the proposed method. Model results were found to agree closely with available experimental data.

*Keywords:* Frost formation, mathematical modeling, moving boundary, orthogonal collocation, heat transfer, mass transfer.