The APP As a Tool, a First Principles Approach

R. W. Pryor[1]

[1]Pryor Knowledge Systems, Inc., Bloomfield Hills, MI, USA

Abstract

The app discussed in this paper is based on a COMSOL Multiphysics® 1D heat transfer model that analyses the heat flow through a double pane window, with a gas chamber between the two panes, as would normally be mounted in the wall of a building, a container or a refrigerated chamber. The double pane window has air on both the inner and outer sides, and a gas of choice between the two panes. The app allows the modification of inner and outer temperatures, the modification of pane material parameters, pane spacing and the selection of the gas between the two panes. The 1D model provides results for evaluation much more rapidly than an equivalent 2D or 3D model.

This app models the calculation of heat loss (gain) under stationary (steady-state) conditions, for a wide range of applied conditions. New physical parameters for the materials (heat capacity, density, thermal conductivity) may be entered along with the heat flux to allow a broad range of layered material calculations. The app is suitable for the modeling of the calculation of heat loss (gain) in rooms, greenhouses, ovens, experimental chambers, battery-pack separation, etc. The structural concept of the underlying model has been employed to significantly reduce the prospect of cascade thermal runaway in experimental high-density Li-ion battery pack assemblies.

The conclusion of this paper is that this 1D APP facilitates accurate First Principles analysis to show preliminary evaluation results. This APP allows the modeler to determine the proper direction to pursue when undertaking further difficult, complex problem calculations that potentially require additional 2D or 3D analysis.

Building an application (APP) from an exploratory model and running it with COMSOL Server allows non-modeling scientists, engineers and staff to explore combinations of design and material changes that they could not easily explore otherwise. This allows all members of the company structure to more easily reach accommodation on the design of a new or revised product.

Figures used in the abstract

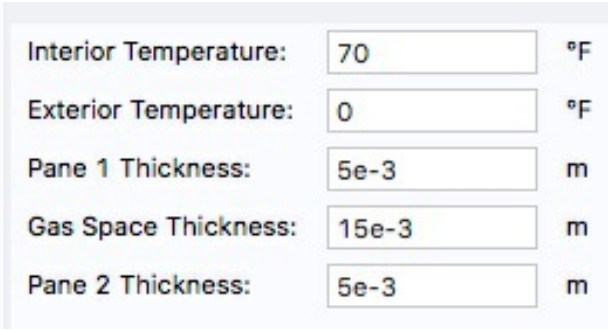

Figure 1: 1D Double Pane Gas Spaced Window Input Parameter Fields