Optimization of Active Packaging for Microwaveable Food Products Using COMSOL Multiphysics®

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Abstract

Upon operation, the magnetron of a conventional microwave oven induces a pattern of standing electromagnetic waves in the oven cavity. Interactions with the field define the amount of energy absorbed in a part of a food object within the cavity. The well-known inhomogeneous heating produced in a microwave oven is partially an effect of the standing waves' natural nodes and antinodes and partially due to an inhomogeneity of dielectric properties in the food, as well as the food's shape and dimensions. Since the dielectric properties of a piece of food are only open for minimal alteration, by recipe revision for example, and dimensions and shape of the food are imposed by consumption needs, it is in the adaptation of the electric field that the solution for homogeneous heating must be found.

COMSOL Multiphysics® simulations of a microwave oven using the RF Module have led to several interesting observations regarding the change in electric field. A metallic shield surrounding an object has been found to focus the field inside itself. This provides for more homogeneous and intensive heating. Certain metallic patterns enclosing the food from the top and bottom have also increased homogeneity by limiting and distributing field penetration through the object. Practical experiments have been performed to verify the results of the simulations.