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In-situ Single Mode Dielectric Measurements of microwaveable snack pellets

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Abstract

The dielectric properties of starch based snack pellets have been measured in situ during microwave heating and expansion. The microwave setup consists of a single mode shorted waveguide, equipped with a six-port impedance analyser which measures the absorbed power and complex reflection coefficient during heating. The pellet is suspended in the electric field maximum, with an optic temperature sensor inserted in the centre. The dielectric properties of the pellet during heating and after expansion are obtained via an inverse mapping of the recorded reflection coefficient to dielectric properties, which are pre-computed via finite elements simulations.

Experiments show that the dielectric properties of the starch pellets change significantly during heating, expansion and subsequent drying. The dielectric properties increase with increasing temperature up to the moment that the pellet starts expanding. Subsequently, the power absorption shows a sudden decline, which is mainly due to the sudden change in porosity. Addition of salt (2.5%) to the starch pellet composition results in a slight decrease of the dielectric constant and loss factor, as it apparently lowers the effective mobility of the dipoles. The dielectric properties as function of temperature and moisture content were fitted with a polynomial model. The strong effect of porosity for the dielectric properties of the expanded snack is well predicted with the effective medium mixing rule.