Coplanar Waveguide Techno TEMPO Oxidized Thermomechanical Pulp – Based Microwave Humidity Sensor

Guy Ayissi Eyebe[1], David Myja[2], Benoit Bideau[2], Robert Lanouette[2], Éric Loranger[2], and Frédéric Domingue[1]

[1] Electrical and Computer Engineering, Université du Québec à Trois-Rivières, G9A 5H7, Canada.
[2] Institut d'Innovations en Écomatériaux, Écoproduits et Écoénergies, Université du Québec à Trois-Rivières, G9A 5H7, Canada.

Abstract—The thermomechanical pulp (TMP) is a product of lignocellulosic biomass. This paper investigates TEMPO oxidized TMP (TO-TMP) as an ecofriendly, low-cost and highly sensitive dielectric material for humidity sensing applications. The TEMPO oxidation was used to increase the water absorption of TMP while overcoming the adverse hydrophobic effects imparted from lignin. The physical and the dielectric effects of TEMPO oxidation on a TMP sheet having a carboxyl rate of 80 mmol/kg were studied. An experimental validation with an original sensing scheme in frequency shift paradigm involving a microwave resonator in coplanar waveguide (CPW) technology was proposed. In the 52 – 75.3 %RH range, the sensitivity rose from 7.76 MHz/%R to 9.04 MHz/%RH after the TEMPO oxidation increased the carboxyl content to 1164 mmol/kg, and to 12.1 MHz/%RH when the carboxyl content was enhanced up to 2233 mmol/kg. The effects of the TEMPO oxidation degree and the thickness variation are also studied.

Reference:
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