The Correlation of Pickled Fish and Frequency Response using Parallel Coupled Lines Band Stop Filter Microstrip

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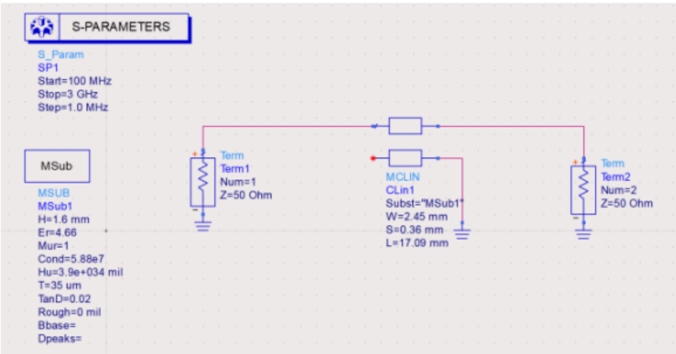
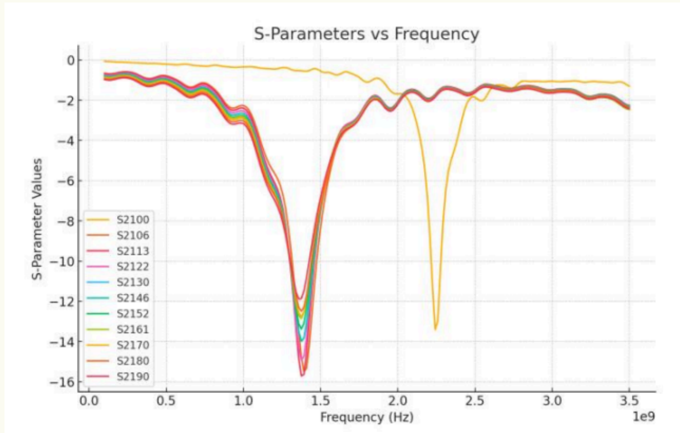
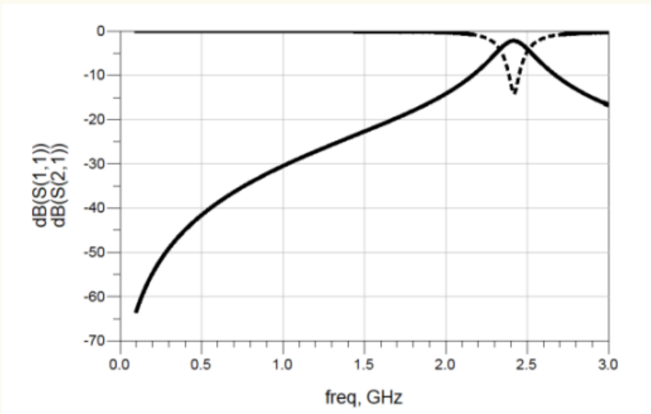
ABSTRACT: Abstract: This research presents the development and analysis of a microwave sensor designed with a microstrip band stop filter, aimed at applications in electrical engineering and food quality assessment. The sensor employs parallel coupled lines within the microstrip, integrating a band stop filter at 2.45 GHz on an FR4 substrate. The primary objective is to evaluate preserved fish samples to demonstrate the sensor's efficacy and applicability. Measurements were conducted using a KEYSIGHT model E5063A network analyzer, covering a frequency range from 0.1 GHz to 3 GHz. The analysis focuses on the frequency response of the insertion loss (S21) across specified frequencies. The results indicate a significant correlation between the percentage shift in the transmission coefficient and the frequency, even when the sample range was meticulously adjusted. These findings underscore the potential of microwave sensors in monitoring the physical properties of preserved food, particularly within food production and quality control processes. The sensor facilitates rapid and precise assessments of food properties, highlighting its broad applicability in various sectors of the food industry. Furthermore, this research contributes to the advancement of microwave technology, suggesting new pathways for future studies and applications in engineering and industrial contexts. The integration of microstrip technology with band stop filters in sensor design presents a novel approach that enhances the accuracy and efficiency of food quality monitoring systems. This study not only establishes a foundation for further technological developments but also emphasizes the interdisciplinary nature of modern engineering solutions, combining principles of electrical engineering with practical applications in the food industry. This innovative approach could lead to more sophisticated and reliable methods for ensuring food safety and quality.

Keywords: Pickled fish; Frequency response; Parallel coupled lines; Band stop filter ; Microstrip



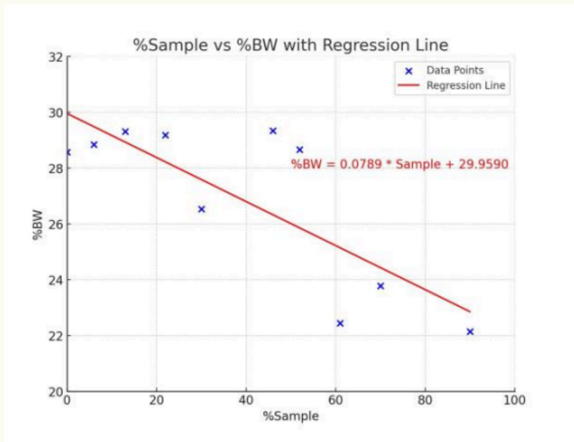
Design and simulation of microwave sensor using parallel coupled lines microstrip

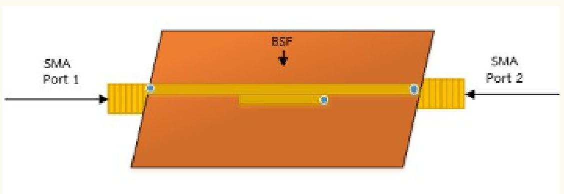




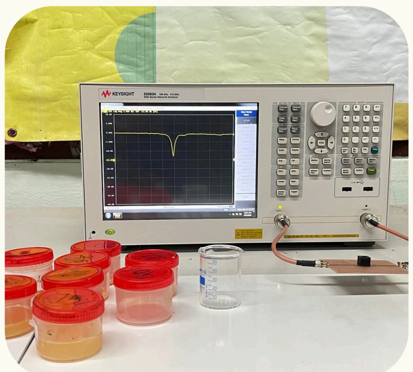
Simulation results of microwave sensor using parallel coupled lines microstrip

The measurement results show that the microwave sensor with a microstrip structure maintains a stable bandwidth (%BW) of around 28-29% when the salt concentration is between 0-52%. However, when the salt concentration exceeds 61%, the bandwidth decreases to around 22-23%, indicating that the sensor becomes more sensitive and precise in detecting changes in dielectric properties as the salt concentration increases.





Prototype of Microwave Sensor Using Parallel Coupled Lines Microstrip



Experimental setup of microwave sensor using parallel coupled lines microstrip

sThe correlation between salt concentration and %BW shows a clear negative trend, where an increase in salt content leads to a decrease in %BW, indicating a narrower bandwidth. The regression equation %BW = -0.0789 × Sample + 29.9590 confirms that as salt levels rise, the microwave sensor becomes more selective, enhancing its ability to detect changes in material properties.

Conclusion

In conclusion, this study demonstrates the effectiveness of a microwave sensor based on parallel 8 coupled microstrip lines for detecting changes in the dielectric properties of pickled fish samples 9 with varying salt concentrations. The results show a clear correlation between salt content and the 10 sensor's performance, particularly in terms of percentage bandwidth (%BW) and Q factor. As the 11 salt concentration increases, the sensor becomes more selective, with a narrowing bandwidth and 12 increasing Q factor, indicating its heightened sensitivity to higher salt levels. This sensor design 13 offers a reliable and efficient method for non-invasive, real-time monitoring of food quality, mak- 14 ing it a valuable tool for applications in the food industry.