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# Substrate-integrated waveguide (SIW) microwave sensor theory and model in characterising dielectric material: A review

Khair, Nazmus Sakib<sup>a</sup>; Talip Yusof, Nurhafizah Abu<sup>a, b</sup> ; [Wahab, Yasmin Abdul<sup>a</sup>](#); [Bari, Bifta Sama<sup>a</sup>](#); [Ayob, Nur Idayu<sup>c</sup>](#); [Zolkapli, Maizatul<sup>d</sup>](#)[Save all to author list](#)<sup>a</sup> Faculty of Electrical Electronics Engineering Technology, Universiti Malaysia Pahang, Pahang, Pekan, 26600, Malaysia<sup>b</sup> Centre for Research in Advanced Fluid Processes, Universiti Malaysia Pahang, Lebuhraya Tun Razak, Gambang, Pahang, Kuantan, 26300, Malaysia<sup>c</sup> Department of Materials and Manufacturing Engineering, Faculty of Engineering, Islamic International University Malaysia, Jalan Gombak, Kuala Lumpur, 53100, Malaysia<sup>d</sup> School of Electrical Engineering, College of Engineering, Universiti Teknologi MARA Malaysia, Selangor, Shah Alam, 40450, Malaysia[View PDF](#) [Full text options](#) [Export](#) [Abstract](#)[Author keywords](#)[SciVal Topics](#)[Funding details](#)**Abstract**

Microwave sensors offer appealing features such as susceptibility, quick response, and non-invasiveness, making them valuable tools for highly accurate measurements of material characterisation. A wide range of techniques, including cavity waveguide, planar transmission line, cavity waveguide perturbation, open-ended coaxial probe, and free-space transmission, have been employed to characterise materials that are essential for their cost-effectiveness, ease of manufacturing, high sensitivity, good quality factor (Q-factor), and compact size, allowing them to be

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Microwave sensor for liquid classification and permittivity estimation of dielectric materials

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applied to different material types. Among the microwave sensor types, the substrate-integrated waveguide (SIW) has emerged as a promising technology in order to characterise materials in an efficient manner. This paper presents a review of the current state and potential opportunities of SIW microwave sensors in the characterisation of dielectric materials. It provides insights into various design principles, techniques, and applications of SIW microwave sensors across different sectors, highlighting their advantages and limitations compared to conventional waveguide-based sensors. Furthermore, the paper summarises several fabrication methods that can be implemented for SIW microwave sensors to enable the production of efficient and reliable sensors. Additionally, the future directions provided in this paper aim to contribute to the ongoing development and optimisation of SIW-based microwave sensors for accurate and efficient dielectric material characterisation. Overall, this review article serves as a beneficial resource for new researchers seeking to understand the role of SIW microwave sensors in material characterisation. It outlines the current status, opportunities, and potential advancements of SIW sensors, shedding light on their significance and potential impact in the field of material characterisation. © 2023 The Authors

## Author keywords

Dielectric; Material characterisation; Planar waveguide; Sensor; SIW

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