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Accession number:20122915250831
Title:Open-ended waveguide measurement and numerical simulation of the reflectivity of petri dish supported skin cell monolayers in the mm-wave range
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Source title:Journal of Infrared, Millimeter, and Terahertz Waves
Abbreviated source title:J. Infrared. Millim. Terahertz Waves
Volume:33
Issue:5
Issue date:May 2012
Publication year:2012
Pages:529-547
Language:English
ISSN:18666892
E-ISSN:18666906
Document type:Journal article (JA)
Publisher:Springer New York, 233 Springer Street, New York, NY 10013-1578, United States
Abstract:Open-ended waveguide reflectometry is a promising tool for permittivity and other material properties calculation at mm-waves (30-300 GHz). Measurement of the reflection coefficient does not require sample manipulation, allowing in vivo and in vitro non destructive studies on cells. Here we used this technique for measuring the power reflection coefficient (reflectivity) of water and Petri dish supported human skin melanoma and keratinocyte cell cultures, in the 53-72 GHz frequency range. The dependence of the reflectivity on polystyrene or glass thickness of the Petri base plate and on the cell layer thickness was analyzed. Permittivity data were then easily retrieved by using a plane wave-dominant mode approach for formulating the reflectivity at the aperture of the flange-mounted open-ended rectangular waveguide probe. Limits and validity of such an approximate approach were analyzed and compared with full-wave near field formulations for which magnitude and phase of the reflection coefficient must be measured and solved using complicated systems of integral equations and extensive numerical calculation. Finally, Petri dish reflectivity measured by the open-ended waveguide method was compared with that numerically simulated under far-field exposure conditions used in a large number of in vitro studies. Such an analysis showed that, under certain conditions, open-ended reflectivity values approach the far field ones. © Springer Science+Business Media, LLC 2012.
Number of references:57
Main heading:Reflection
Controlled terms:Cell culture - Cells - Computer simulation - Millimeter waves - Molecular biology - Monolayers - Permittivity - Polystyrenes - Waveguides
Uncontrolled terms:A-plane - Base plates - Cell layers - Cell monolayers - Complicated systems - Exposure conditions - Far field - GHz frequencies - Glass thickness - Human skin - In-vitro - In-vivo - Keratinocytes - Material property - Mm waves - mm-Wave - Mode approach - Near

fields - Non destructive - Numerical calculation - Open ended waveguides - Petri dish - Power reflection coefficient - Reflectivity values - Reflectometry - Sample manipulation
Classification code:815.1.1 Organic Polymers - 813.2 Coating Materials - 723.5 Computer Applications - 714.3 Waveguides - 711 Electromagnetic Waves - 701 Electricity and Magnetism - 461 Bioengineering and Biology
DOI:10.1007/s10762-012-9888-8
Database:Compendex