Virus detection by using dielectric microwave waveguide spectroscopy

KEYWORDS

- ❑ DIELECTRIC SPECTROSCOPY
- ❑ MICROWAVES
- ❑ VIRUS
- ❑ REAL-TIME MONITORING
- ❑ NON-INVASIVE DETECTION

AREA

- ❑ ELECTRICAL ELECTRONIC & ICT ENGINEERING

CONTACTS

➢ PHONE NUMBERS
+39.06.49910888
+39.06.49910855

➢ EMAIL
u_brevetti@uniroma1.it

Priority Number
n. 102021000030557_02.12.2021

Patent Type
Patent for invention

Ownership / Co-Ownership
Sapienza 25%, INAF 40%, CNR 10%, ISS 25%

Inventors
Apollonio Francesca, Micaela Liberti, Pietro Bolli, Anna Brucalassi, Simone Chiarucci, Luca Cresci, Ciro Del Vecchio, Paola Di Ninni, Dario Panella, Renzo Nesti, Andrea Tozzi, Claudio Argentini, Giulia Marsili, Marco Barucci

Industrial & Commercial Reference
The industrial sector of reference is undoubtedly the biomedical one; potential markets are those related to rapid, fast and low-cost virological tests for mass screening

Time to Market
The state of development is identifiable in a TRL3 level having been obtained the first experimental results.

Availability
Licensing, Research, Development, Experimentation and Collaboration.

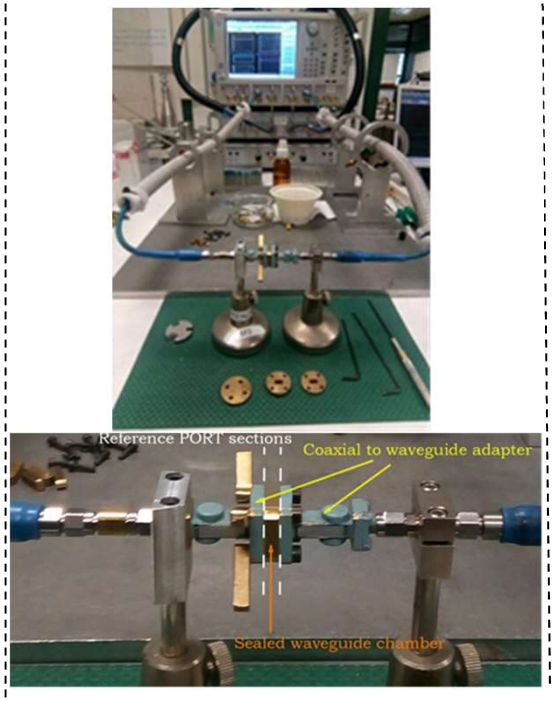


Fig. 1 Images of the measuring bench set up at the Arcetri Astrophysical Observatory. The left image shows the measuring instrument in the background and the connection lines to the sample holder; this last section is instead enlarged in the image on the right.

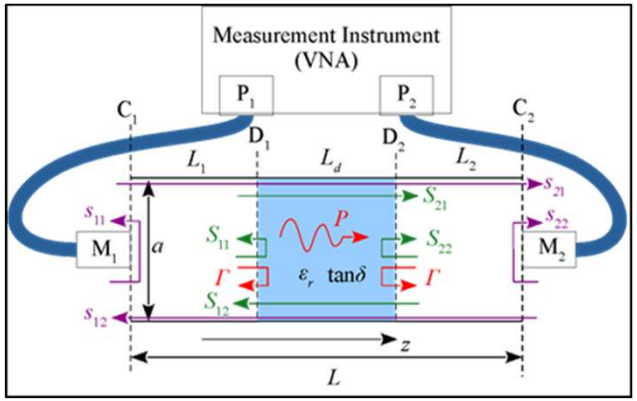


Fig. 2 Diagram of the operating principle of the measuring instrument consisting of VNA connected through two sections of coaxial cable and two transitions to the wave guide that contains the solution being measured.

Abstract
The invention consists of a procedure, made up of the set of a hardware set-up, a measurement methodology and a subsequent numerical processing of the acquired data, capable of detecting, through the dielectric spectroscopy technique applied in the frequency band of microwaves, the presence of viral agents immersed in a buffer solution.
The proposed technique aims at establishing, in a quick and operationally easy way, the possible presence of different types of viruses from the sample under examination, by directly detecting the intrinsic permittivity of the target solution using a broadband dielectric spectrum.

SAPIENZA UNIVERSITÀ DI ROMA

ASuRTT _ UFFICIO VALORIZZAZIONE E TRASFERIMENTO TECNOLOGICO
SETTORE BREVETTI E TRASFERIMENTO TECNOLOGICO
➢ http://uniroma1.it/ricerca/brevetti

Virus detection by using dielectric microwave waveguide spectroscopy

Technical Description

The invention consists of a procedure capable of detecting, through the use of microwaves, the presence of viral agents present in a reference buffer solution. The method is based on a differential approach of microwave dielectric spectroscopy in which a reference measurement of the solution is first carried out in the absence of viral agents and then a second measurement of the solution of interest. Tests carried out on virus-like particles (VLP) and conducted within the INAF laboratories have allowed to verify the presence of VLPs in aqueous solution (for example phosphate buffer saline) with satisfactory characteristics in terms of sensitivity and repeatability of the results.

Technologies & Advantages

The use of microwave dielectric spectroscopy has led to numerous breakthroughs in biological investigations, particularly in molecular and cellular analysis. In fact, it offers the advantage of being non-invasive, allowing a non-destructive characterization of the sample under test with a high detection rate. Furthermore, possible contamination or perturbation of the biomaterial is completely eliminated during characterization and the detection area can be easily sized for very small volumes of biological samples

Applications

Currently, the system has been created and tested at the laboratory level using commercial instrumentation and creating suitable sample holders for the appropriate waveguide measurement cells designed to contain the biological test samples. This prototype measurement system has demonstrated the validity of the proposed procedure. It needs further engineering developments to raise its TRL, as regards its portability, the overall cost of the equipment, and the protocols related to the treatment of viral agents.
Now the tests have been limited to virus-like particles characterized by non-infectious properties, not containing viral genetic material. Once the measurement system has been optimized by improving its portability characteristics and the measurement protocol itself, ensuring the safety of the operators, it will be possible to carry out measurements on real viruses within the laboratory with bio-security level 3 or 4.

Fig. 3 (left) Debye model of water in the microwave spectrum; (center) experimental characterization (relative permittivity); (right) experimental characterization (tangent delta).

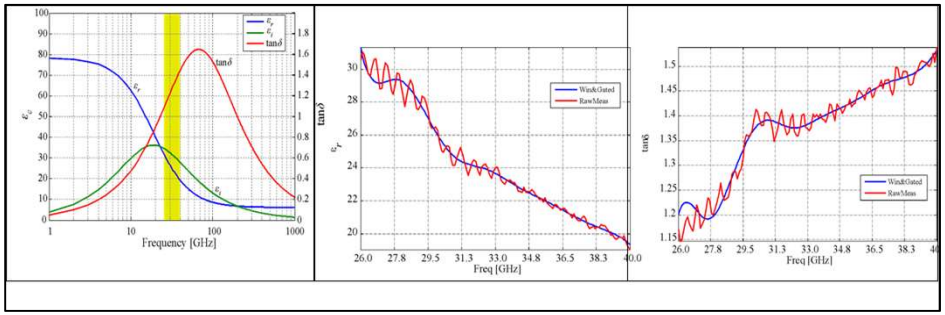
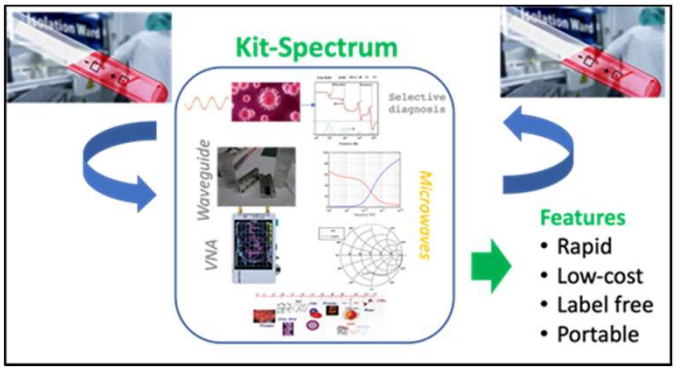


Fig. 4 Scheme of the proposed patent.



CONTACTS

➢ PHONE NUMBERS
+39.06.49910888
+39.06.49910855

➢ EMAIL
u_brevetti@uniroma1.it

SAPIENZA UNIVERSITÀ DI ROMA

ASuRTT _ UFFICIO VALORIZZAZIONE E TRASFERIMENTO TECNOLOGICO
SETTORE BREVETTI E TRASFERIMENTO TECNOLOGICO
➢ http://uniroma1.it/ricerca/brevetti