

3D-Printed Patch Antenna for Dielectric Measurement of Biological Samples

Aditi Gupta, Deepali Jain, Zeeshan, Mridul Kumar and Saomi Daya Krishnananda

*Microwave Physics Lab, Department of Physics & Computer Science,
Dayalbagh Educational Institute, Dayalbagh, Agra-282005*

Abstract—With increasing demand in communication technology, microwave devices capable of operating in multiple frequency bands are being introduced. Microwave technology is not only used for characterization of microwave devices, but also helpful in studying dielectric parameters such as permittivity and loss tangent of biological samples. To serve this purpose, customizable antennas are the prime choice of researchers. In this study, we report design, fabrication and simulations of a 3D printed microstrip patch antenna. Furthermore, the designed antenna was used to find dielectric parameters of different amino acids. In the presented study, the resonant frequency of main patch antenna was at 20 GHz. The patch was designed using Polylactic acid (PLA) substrate and was fabricated using Anycubic® i3 Mega 3D printer. The simulations were done using CST Studio Suite 2022 and testing was performed using a Vector Network Analyzer (VNA Rohde & Schwarz ZVA-67). Thereafter, results presented in this study were used for the comparative analysis of three amino acids. L-Glutamic acid, L-Tryptophan acid and O-Benzyl-L-serine. Individual samples and their combinations were taken and compared on the basis of their quality factor, permittivity and loss tangent. Our results show that permittivity of combination of amino acids is more than the pure amino acids. Furthermore, for the case of L-Glutamic acid and O-Benzyl-L-serine, loss tangent of combinational amino acids is less than the pure amino acids whereas in L-Tryptophan, the loss tangent of combinational amino acids is more than the pure amino acids. Such studies can help in understanding structural, compositional and functional analysis of biological samples.