Application of microwaves on dental diagnose

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Abstract **The aim of our work is to present application of microwaves and compare dielectric properties of dental material without defects in defined frequency range and subsequently comparing properties in defective material as changes in material and classifying the occurrence of inhomogeneities as on the surface so inside the structure.**

Keywords **Dental material, dental diagnose, dielectric properties, microwaves.**

I. INTRODUCTION

Dental diagnostic is already based on upper absorption of electromagnetic wave into a tooth and dental material, which might be potential caries in tooth or defect in dental material. It is caused by statistic that healthy tooth has lower water content. This fact exhibits low loss at microwave frequencies. It was published that coefficient of transmission for tooth without caries (healthy tooth) and parts with defect (diseased parts) of the tooth differ as much as 10 dB in the frequency range of 75-110 GHz how is published in [1].

Our aim is monitoring behavior of microwaves into biomaterial through dielectric properties of tooth and dental material, especially in the frequency range from 8 to 12 GHz and exploring new possibilities of application new materials elements. That is very important to improve quality of biomaterials and level of cure.

II. PRIMARY CONCEPT OF TOOTH DIAGNOSE

In dental practice are a lot of objective diagnostic realized by X-ray imaging. Nevertheless, use of X-rays has two primary disadvantages: firstly, X-rays damage the human tissue caused by their radiation dose and secondly in dental practice is difficult to vary healthy tooth tissue from the affected tooth or from dental material with defect. That is reason why we are interest in possibility of using microwave technology for dental diagnostic and treatment [1], [2].

III. MEASURING THE DIELECTRIC PROPERTIES

Investigation of any material can be described by three basic electromagnetic properties of the exploring material: relative permittivity ε_r, relative permeability μ_r and conductivity. Presently, there are many measurement applications used in medical research, [3].

We chose non-resonant reflection waveguide method for measuring. We selected a rectangular waveguide, which is a rectangular metal pipe which guides high frequency electromagnetic waves from one place to another without significant loss in intensity. This method determines accurately the dielectric constant of thin and moderate thick samples, [4].

For measurement method, we used Hippel method, which is considered as the most accurate waveguide method. This sample is always adapted to the dimensions of waveguide WR-90 (2.286 cm x 1.016 cm) 8.2 to 12.4 GHz, [4].

Fig. 1: a) Our used workplace ordering of experimental measurements, b) the used sample of poly methyl methacrylate

According to the relevant mathematical expression, we can calculate relative permitivity ε_r and also loss factor $tg\delta_\varepsilon$ of tooth or selected dental material:

The calculated dielectric parameters can be used in simulation. These values are very indispensable for our next research, in which we want to create phantoms with the same dielectric properties.

IV. CONCLUSION

The application of microwave has two basic significations: firstly, diagnose of tooth decay (or defect in used material) through dielectric properties, secondly, distribution of temperature warmed by microwave energy (millimeter electromagnetic waves) has revealed that dental caries are simply heated. It means that this type of energy can be used as a treatment in dental practice in the early stages of tooth decay. It could be hopeful new technique which may eliminate the use of X-rays.

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VI. REFERENCES

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