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UVP Distribution and Device for Imaging Physiochemical Property of Nanoparticles or Ionic Species in Colloids

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Abstract

Ultrasound vibration potential (UVP) is an electroacoustic phenomenon due to ultrasound applied to the colloid particles and ionic electrolyte. Particles/ions in electrolyte carry electrical charges. When excited, charged particles/ions vibrated and generate a secondary electric field that produces the so-called ultrasound vibration potential comprising two categories of Colloid vibration potential (CVP), or Ion vibration potential (IVP). They are functions of the physiochemical features of particles or ions in the colloid along the path of the ultrasound beam. The present research focuses on understanding of ultrasound vibration potential distribution (UVPD) in a 3-dimensional object for sensor optimisation. A mock body made from Agar and associated experimental methods (Leeds standard III) were established for the purpose of tissue imaging. A new disc-dipole model is developed to address the UVPD inside the mock body and reveal the optimisation sensor set-up. . The sensing device with electrodes nonintrusive set outside the mock body successfully received signals from agar samples, containing either ionic or Nano-particular spics, embedded inside the mock body, providing the physiochemical property of these samples. The signals are either a function of atomic mass or particle size in respect to the physiochemical characterizations of ionic spics and Nano-particles. This work provides a new method based on ultrasound technology and demonstrated a high potential to develop a new measurement and imaging technology for online charactering physiochemical properties of colloids in engineering and complimentary imaging in medicine.

Keywords: Ultrasound, Colloids, Physiochemical, Ultrasound Vibration potential Distribution.

Introduction

The concept of ion vibration potential for electrolytes originally back to [1]. He has initially presented this idea, when the sound wave propagates through an ionic electrolyte an electrical signal generated due to the displacement of ions which caused by the ultrasound field. In the past, most researches were focused on the effects of CVP/IVP form a sampling chamber, but few studies on the properties of the electric field generated by ultrasound vibration. Since 2005[2], Researchers have started an investigation to utilize ultrasound propagation to non-intrusively imaging physiochemical properties of objects inside a medium, they mostly focusing on the sensing method, and developing the method for detecting UVP [3]. We demonstrate the new sensing system to measure the UVP and mock tissue setup. It provides the evidence of detecting the physiochemical property of an object and multiple objects inside the mock tissue model in this report. The electric field distribution inside the mock body explained. The equivalent circuit model of this measurement technique explained.

Methodology

The Experiment consists of two parts input and output. The input instruments are the signal generator [Agilent 33250A] is set with, $450mV\,(pk-pk)$ 1MHz frequency and six duty cycles, burst period 50ms, and the duty cycle of 0.01%. This burst amplified by an RF amplifier [GA-2500A, RITEC], for up to $(1000V\,(pk-pk))$. The Output from RF amplifier connected to a matching resistor 50Ω and 1MHz piezoelectric Transducer [Sonatest.ltd], which fixed at one side of the agar block to apply the amplified ultrasound wave into the agar mock body and the sample. The output of this experiment consist of two electrdes made from aluminum foil with the dimension of $(10\times10mm)$ to detect the UVP signal and ultrasound pulser receiver

[5072PR.RD.Tech] with the gain factor of 39dB to amplify the received signal and the digital Lecory oscilloscope [LT374, Maxim Instruments].
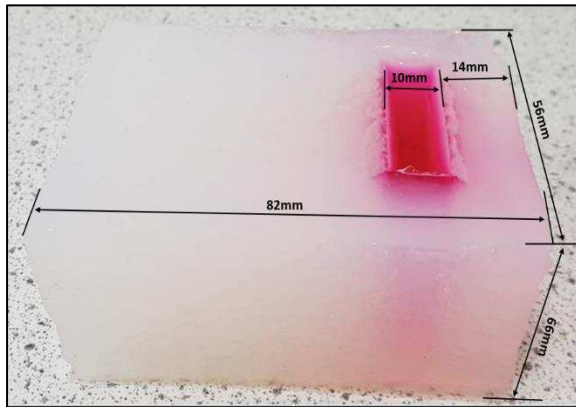

Figure 1-1 Mock body model.

Conclusions

The signal detected for multiple samples inside a mock tissue model. The ultrasound vibration potential distribution (UVPD) presented to provide an information to optimize the UVP device measurements. This work demonstrated a high potential to develop an innovative technology for nanoparticle characterization in engineering and physiochemical imaging for medicine.
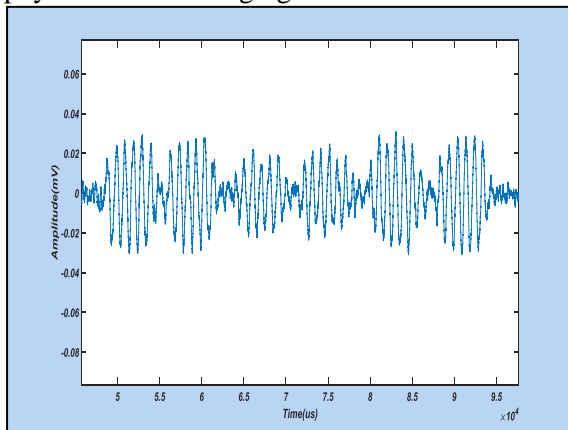

Figure1-Error! No text of specified style in document.**-2 - CVP Signals for 3 Layer samples of (SiO2, 21nm).**

Figure 1-2 shows the six burst of UVP signal. The CVP signal generated at each side of the sample with varies amplitude.
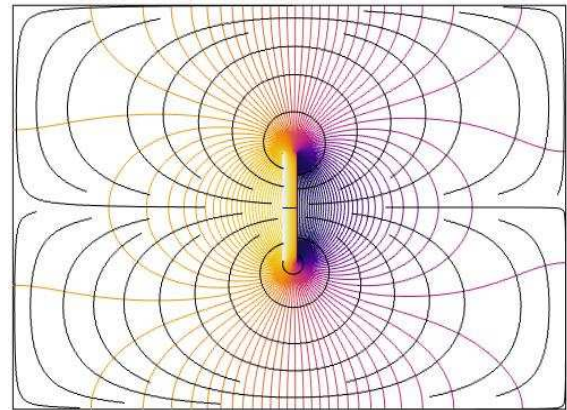

Figure 1- -3 UVPD Equipotential lines.

The electric field distribution based on dipole model to analyses the signal amplitude and focusing disc dipole presented. The evidence of detecting different ion recipe by UVP model presented. This model may require further improvement to the sensing method, and imaging constructions.

References

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