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Experimental Study of Dynamic Vibration on Prototype Auditory Membrane Made of PVDF

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Abstract: In this paper, we investigate the vibration dynamics of the prototype auditory membrane (PAM) for a fully implantable artificial cochlea. The shape of PAM is trapezoidal and elastic membrane which is fabricated using MEMS technology. The dynamics are measured as an echo signals of transient vibrations induced by pulsed sine waves which are applied from top and one side of the PAM. The PAM vibrations are analyzed based on the Fourier analysis; it is found that the PAM can realize the frequency selectivity of the various frequency.

Key Words: Basilar membrane, Frequency selectivity, PVDF, PAM

1. INTRODUCTION

Cochlear implants usually use to assist the human when they have deafness caused by the sensorineural hearing loss. We develop the Prototype Auditory Membrane (PAM) as a novel acoustic sensor which is a part of the fully implantable artificial cochlea. In the previous study, we investigate the vibration of the membrane at the periodic steady state using continuously applying acoustic sinus wave. Previously, we use the speaker to apply the sound wave into the membrane. In this research, we report the vibration dynamics of the PAM which is induced by pulse sine waves and sound wave. We develop the PAM which is one of part of the artificial cochlea.

2. DESIGN AND GEOMETRY

In the previous our experiment, we are discuss about investigated frequency selectivity of the membrane using certain frequency. The standing wave and resonance frequency are detected and observed along of the membrane.

In this work, we apply one cycle of sinusoidal wave on the PAM using actuator and speaker. Comparison dynamics vibrations between them are observed experimentally. The sinusoidal wave of actuator and speaker are applied on the PAM with magnitude of voltage 2 V and frequency f of 5 to 20 kHz and 3 to 15 kHz, respectively. All of the frequencies are set in the human auditory. The function generator is used to set the frequency and amplitude voltage and amplifier is used to amplify the magnitude of voltage. The method of pulse echo is apply in the experiment. The basic principle of the method detect and analyze the received vibration signal with time between emission from actuator and reception along of the PAM.

The PAM is fabricated using microelectromechanical system (MEMS) technology. Design and geometry of the PAM is shown in the figure 1. The PAM has 40 μ m thickness of