Neuromuscular Function And Disease: Basic, Clinical, And Electrodiagnostic Aspects

The 2013 Biomedical Engineering International Conference (BMEiCON-2013)

Piezoelectric polyvinylidene fluoride thin film as monitoring sensor

Nikruesong Tohluebaji
Department of Physics,
Faculty of Science, Prince of Songkla University
Songkla, Thailand
5510220056@email.psu.ac.th

Nantakan Muensit
Department of Physics,
Faculty of Science, Prince of Songkla University
Songkla, Thailand
nantakan.m@psu.ac.th

***Abstract*— This study proposes a piezoelectric polyvinylidene fluoride (PVDF) patch for detecting the movement of the biceps brachii muscle. The polyurethane (PU) elastomer was chosen to perform as an artificial muscle. The PVDF patch rigidly glued onto the stretching PU strip could generate the charge linearly with its applied force. The large strain of 1-4 % of the PU at a low driving voltage has led to the determination of the piezoelectric charge coefficient (d_{31}) of 30 pC/N for the PVDF. The sensing PVDF-PU patch in this study is promising for detecting the electromyography of the biceps brachii muscle movements which can be repeatable used with ease.**

***Index Terms*—PVDF, piezoelectric, EMG, elastomer, BB muscle.**

I. INTRODUCTION

Standard vital signs, including heart rate, respiratory rate, body temperature, blood pressure and muscle (electromyograms) are the important physiological parameters that are commonly taken by health professionals in order to assess basic functions of human body. Among the vital parameters, the study of electrical signals in muscle (electromyograms) can be a valuable aid in discovering and diagnosing abnormalities in the muscles. It is, thus, of great importance to routinely monitor the muscle particularly for the people diagnosed with high risk of the above abnormalities. Electromyography (EMG) is the interpretation of these muscle action potentials. Recently, the electromyograms have been recorded for achieving artificial control of limb movement and rehabilitation [1]. Technical procedures used in recording and analyzing electromyograms have been done by the available technology. This includes the needle electrode of high mechanical qualities and stable, which leads to the reproducible measurements [2]. Several sensing devices have been widely adopted clinically but, however, not in home care because of the following limitations, i) only a few sensing devices can obtain cardiorespiratory information concurrently, and ii) the application of the devices needs skillful persons to operate and acquire reliable data. In addition, the electrodes in the EMG operation may cause discomfort and inconvenience to the users, particularly for long-term vital sign monitoring [3].

To monitor the signals derived from the muscle movement, an interesting polyvinylidene fluoride (PVDF) has been recently utilized through the piezoelectric effect [3-4]. PVDF-based sensors generate the electrical signals while it is mechanically deformed. The material properties which are thin, flexible, light and particularly suitable for fabricating a portable sensing device have widely promoted the PVDF polymer film for many medical applications. This work also pays attention to the PVDF film and proposes the PVDF sensor patch for detecting the movement of a biceps brachii (BB). This is based on the vibrations and periodical deformations of the skin wall of human body during the physiological movements of BB muscle. The movement in turn mechanically stimulates the piezoelectric PVDF film to generate the corresponding electrical signals.

II. MATERIAL AND METHODS

A. Materials and Background

A commercial metallized PVDF sheet with a dimension of 190 mm×280 mm (part no. 1-1004346-0, Measurement Specialties Inc.) was used in this work. The PVDF sample was cut from the poled PVDF sheet into a rectangular geometry. The commercial PVDF exhibits the piezoelectricity and possesses high piezoelectric phase which has the orthorhombic crystal system. The constitutive equations for the PVDF system are, therefore, given by:

$$D = dT + \varepsilon^T E \quad (1)$$

$$S = s^E T + dE \quad (2)$$

where D is the dielectric displacement, d is the piezoelectric coefficient, ε^T is the permittivity at constant stress, E is the electric field, S is the strain, s^E is the elastic compliance at constant electric field, and T is the stress. In practice, the PVDF sample under a uniaxial stretch is denoted its reference in Cartesian coordinate axes which are associated with the subscripts in equation (3) as follows:

$$Q_3 = d_{31} F_1 \quad (3)$$

978-1-4799-1467-8/13/$31.00 ©2013 IEEE

Neuromuscular Function and Disease: Basic, Clinical, and Electrodiagnostic Aspects, 2-Volume Set, 1e [William F. Brown MD MD, Charles F. Bolton MD CM MS.Neuromuscular function and diseaseBasic, Clinical and Electrodiagnostic Aspects, Vols 1 and 2. Edited by William F. Brown, Charles F. Bolton, and Michael J.Neuromuscular Function and Disease: Basic, Clinical, and Electrodiagnostic Aspects. Article in Journal of Clinical Neuromuscular Disease 4(2).Volume I emphasizes the pathophysiology of neuromuscular disease and its assessment using electrophysiologic and radiologic tools. Volume Neuromuscular Function and Disease: Basic, Clinical, and Electrodiagnostic Aspects, Volume 1.Neuromuscular function and disease: basic, clinical, and electrodiagnostic aspects, Volume 2. Front Cover. William Frederick Brown, Charles Francis Bolton .NEUROMUSCULAR FUNCTION AND DISEASE BASIC CLINICAL AND. ELECTRODIAGNOSTIC ASPECTS 2 VOLUME SET 1E a motor function measure scale.If you are searching for the book Neuromuscular Function and Disease: Basic, Clinical, and. Electrodiagnostic Aspects, 2-Volume Set, 1e by Charles F. Bolton.Neuromuscular Function and Disease: Basic, Clinical, and Electrodiagnostic Aspects, William F. Brown, Charles F. Bolton and Michael J. Aminoff, editors, WB .Neuromuscular function and disease: basic, clinical and electrodiagnostic aspects / [edited by] William F. Brown, Charles F. Bolton, Michael J. Aminoff.Neuromuscular Function And Disease Basic Clinical And Electrodiagnostic Aspects - In this site is not the thesame as a solution calendar you purchase in a .29 Sep - 24 sec Watch [PDF] Neuromuscular Function and Disease: Basic, Clinical, and Electrodiagnostic.Home > December - Volume 4 - Issue 2 > Neuromuscular Function and Disease: Basic, Clinical, and Ele > Image Gallery.Neuromuscular Function and Disease: Basic, Clinical, and Electrodiagnostic Aspects, Volume 1 - ?-???? ????? ?William Frederick Brown, Charles Francis."Neuromuscular Function and Disease: Basic, Clinical, and Electrodiagnostic Aspects, Volume 1"   William Frederick Brown.NEUROMUSCULAR FUNCTION AND DISEASE 2-VOLS SET: BASIC, CLINICAL, AND ELECTRODIAGNOSTIC ASPECTS (hb)eBooks Neuromuscular Function And Disease Basic Clinical And. Electrodiagnostic Aspects 2 Volume Set 1e are currently available in various formats such as.muscle fibres of a MU via the neuromuscular junction NMJ formed at the terminal end of and comparison of applications of EMG techniques for clinical decision . Simulation models have been devised so that the effects of .. changes in MU morphology and activation created by a disease process lead to expected.Nov 3, - 26 sec - Uploaded by Tracee SegoviaNeuromuscular Function and Disease Basic Clinical and. Electrodiagnostic Aspects 2 Volume. Essentials of.Neuromuscular Function And Disease Basic Clinical And Electrodiagnostic Aspects - In this site is not the same as a solution reference book you purchase in a.Neuromuscular function and disease: basic, clinical, and electrodiagnostic aspects Subject(s): Neuromuscular diseases   Efferent pathways   Neuromuscular.Buy Neuromuscular Function and Disease: Basic, Clinical, and Electrodiagnostic Aspects, 2-Volume Set Revised ed. by William F. Brown MD, Charles F. Bolton.