ANALYSIS OF THE ALIGNMENT AND CRYSTALLINITY OF BULK POLYVINYLIDENE FLUORIDE (PVDF)

NURUL REDZUAN BIN MANSOR

Final Year Project Report Submitted in
Partial Fulfillment of the Requirements for the
Degree of Bachelor of Science (Hons.) Polymer Technology
in the Faculty of Applied Sciences
University Teknologi MARA

APRIL 2009

ACKNOLEDGEMENTS

In the name of Allah S.W.T the most beneficent and most merciful. All praise is due to God. It is deepest sense of gratitude of the Al-Mighty Allah who gives strength and ability to me to complete my thesis report. Firstly, I would like to thanks to my supervisor, Dr. Rozana Mohd Dahan for her encouragement, constructive comments and suggestion, guidance throughout every phase of this project leading its completion. She has perpetually given moral support. I also would like to extend my gratitude and appreciations to the laboratory assistants, Encik Anuar and Encik Joe for their cooperation, undivided effort and support for guiding me in the most of the experiments. Besides that, I would like to take this opportunity to thank my family for their moral and financial support because they heve indirectly helped me completed my thesis. Thanks to my fellow friends for all helped and individual that directly and indirectly involved in this thesis project. Thank you very much and may Allah bless all of you.

Nurul Redzuan Mansor

TABLE OF CONTENTS

ABSTRACT

ANALYSIS OF THE ALIGNMENT AND CRYSTALLINITY OF BULK POLYVINYLIDENE FLUORIDE (PVDF)

The analysis of the alignment and crystallinity of bulk polyvinylidene fluoride (PVDF) was studied. The alignment and orientation of the crystallization were observed by stretching at speed of 5mm/min, 10mm/min, 30mm/min, 40mm/min and 50mm/min. The variation of speed of pulling is to enhance the orientation of the crystals. The samples were observed under the polarized light optical microscopy (PLOM) at 5x, 10x, 20x and 50x magnification. The samples were then annealed at temperature 120°C. The sample was reobserved under PLOM. The stretching was caused a reduction in the sample thickness and resulted in the alignment of the crystals. The speed of pulling at 30mm/min was found to be a favourable because of their clear alignment of the crystals.

CHAPTER 1

INTRODUCTION

1.1 Overview

Polyvinylidene Fluoride is the first commercial polymer for which a D-E (electric displacement - electric field) hysteresis loop and a fast-switching phenomenon were demonstrated because the ferroelectric properties originated from the crystalline region. The experimental data are strongly influenced by the higher order structure, such as the degree of crystallinity, crystal size, crystal orientation and alignment.

The objective of the study is to get a better understanding about the alignment and the crystallinity of polyvinlidene fluoride (PVDF). The piezoelectric applications of (PVDF) are intimately related to the crystalline phase, known as β phase. In addition to this phase, (PVDF) also crystallizes into two other phases, a non polar phase, also known as alpha (α) and a gamma (γ), which is dependent on the temperature. The α (TG+TG-) conformation is the most easily obtainable. The β conformation, which is responsible for the piezo and the pyro-electrical properties, is not easily obtainable. The β phase has a TTTT conformation. Meanwhile, the γ form has a GTTT conformation, whilst the δ corresponds to the polar form of the α phase. (Badr-Eddine El Mohajir et al. 2001)