CHAPTER 1

INTRODUCTION

1.1 Project Background

The liquid crystalline state has been discovered about 100 years ago when Reinitzer and Lehmann (1888) investigated some esters of cholesterol. The field of liquid crystal (LC) developed increasingly in the following decades and about 1970 many researcher in this field believed that the basic knowledge about the LC state would be clear and future research would only serve to detect some details and to fill some gaps. Due to many new discoveries the field of LC has been more enlarged in the last 20 years than in its preceding 80 years of research.

LC can be divided into thermotropic, lyotropic and metallotropic phases. Thermotropic Liquid Crystal (TLC) exhibits a phase transition into the LC phases such as nematic or smectic LC phase when temperature is changed while Lyotropic Liquid Crystal (LLC) exhibits phase transition as a function of both temperature and concentration of the LC molecules in a solvent. Example for the LLC phase is lamellar LC, hexagonal LC, cubic LC and micelle LC. In this project, the research is more focusing on LLC phase that is due to investigate optical and mechanical properties phase, but the probabilities to get the TLC phases like nematic also high. This is because this research will be done with three different temperatures and different of amphiphile concentrations. Metallotropic liquid crystal (MLC) is outside of this research scope.

LC is a substance that exhibit a phase of matter that has properties between those of a conventional liquid, and those of a solid crystal. For instance, LC may flow like a liquid, but it has the molecules in the liquid arranged and oriented in a crystal-like way.

In this research, introduction to the optical and mechanical properties of LC will give many of advantages to the future like in foods, electronics, pharmaceuticals, automotives, shear thickening fluid (STF), cosmetics, nanoparticle synthesis and many more. Mechanical properties are a process that based to the rheological characterizations. Rheology is an important process in LC investigation. Rheology is a process that used to investigate the flow of matter. Part of rheological investigation is very important because LC is found in countless everyday situations. The most popular LC examples are solutions of soap and various related detergents. Soaps and detergents form the LC when they combine with water. Soaps work better than pure water at removing dirt and grease because the nonpolar insides of the micelles are capable of dissolving nonpolar substances that will not dissolve in water. In the kitchen, cake batters may harbor the LC as well. Most importantly, biological membranes display LC behavior (Claus, 1991).

Besides that, LC can be found both in the natural world and in technological applications. Most modern electronic displays are LC based. For example, many proteins and cell membranes are LC. LC also has been used to make stable hydrocarbon foam. Hydrocarbon foams have been difficult to produce in the past because the surface tension of the hydrocarbon is low enough. When LC molecules change from inverse micelles to lamellar sheets, they lower the surface tension enough for foam to form. This is because the hydrocarbon and the surfactant can dissolve in each other, and the surfactant cannot dissolve in water, although water can dissolve in the surfactant and mix into the LC (Kim et al., 1987). This application part will be investigated under the optical characterization. Optical characterization will investigate the phase change of LC at different temperature. In this research, optical characterization will be done by using Polarizing Optical Microscope (POM) and Simultaneous to Wide Angle X-Ray Scattering (SWAXS).

1.2 Problem Statement

In the previous year, there are many researchers that did the investigations in LC field like optical and mechanical properties. However, none of the research used the same method and material. In this research, Triton X-100 and Tapioca Starch will be used as research's materials. The main objectives for this research are investigating the optical and mechanical properties of LC. In other words, it is also can be described as to observe how the LC phase changes with temperature (optical) and find the potential future applications based to the LC phase (mechanical). As a consequence, this research will try to find the solutions in potential applications like shear thickening fluid properties (STF) based to the results of optical and mechanical investigations.

Furthermore, this research also find the solutions in the use of Tapioca Starch. Nowadays, Malaysia has a lot of cassava but not all are in high quality cassava. As a result, this research will try to introduce the usage of Tapioca Starch and find the excellent ideas especially from the rheology process. Besides that, the phase change of LC will be used to investigate the resistance of Tapioca Starch to different temperatures. As a conclusion, it is also gives the advantages to the country in the production of cassava.