CHAPTER I

INTRODUCTION

1.1 Introduction

Conversion of the energy of β particles (emitted upon radioactive decay of unstable isotopes) into a corresponding number of fluorescence quanta is known as scintillation. Through collisions the particles promote nearby atoms or molecules to electronically excited states capable of emitting fluorescence. The number of excited states generated depends on the energy of the β particles, that is, on the decaying isotope. Since it was first described, the scintillation phenomenon has been exploited for detection, counting, and identification of radioactive radiation [1]. Inorganic materials such as thallium-doped sodium iodide [2,3,4], cerium-doped sodium iodide [5,6], bismuth germinate [7,8,9], zinc sulphide [10] and organic scintillators, particularly, 2,5-diphenyloxazole (PPO) shows excellent luminescence and can be tuned to emit over the whole visible spectrum. Other applications of PPOs range from solid-phase synthesis and peptide chemistry, monitoring of protein activity and potassium signaling to radioanalytical chemistry and biomolecule sensing [11,12,13,14]

The liquid scintillation counting method is superior for the detection of weak β radiation from ^{3}H (tritium) or ^{14}C decay [15,16,17,18]. Liquid scintillation counters and many suitable scintillator solutions (cocktails) are available commercially. Although this technique has been developed to give an excellent performance, disposal of the weakly radioactive organic liquid waste is problematic [19,20,21]. The need for further improvement stems from the general tightening in radioactive waste legislation that has been in evidence over the past decade. Ideally, the radioactive waste should be stored in as compact form as possible, and the work necessary to bring it to this state should be kept to a minimum.

There is, therefore, growing interest in polymeric scintillators that can be used for measuring samples stemming from biological, pharmaceutical, and medical research or diagnostics [22,23,24,25]. Polymeric scintillators can be made into a variety of sizes and shapes such as thin film, rod, plate or cylinder and can be used over a broader range of temperatures than liquid scintillator. Polymeric scintillators usually consist of an organic fluorescent compound mixed with a polymer [26,27,28]. In fact, 2,5-diphenyloxazole has been blended into a polymer in order to fully exploit its eventual sensing properties in radioanalytical chemistry technology. Unfortunately, the leaching of 2,5-diphenyloxazole from the polymer was detected after long time exposure to radioactive radiation [29,30]. Leaching occurred because PPO was not chemically incorporated in the polymer matrix. Accordingly, the objective of this research was to solve this problem through the design and synthesis of polymers functionalized with covalently bound PPO moieties. After the appropriate monomers containing PPO moieties were synthesized. They were polymerized with MMA and styrene. The properties of the PPO functionalized and polymers, such as their thermal properties and optical properties were determined.

1.2 Objective

The aim of this research is to synthesize polymers containing a 2,5-diphenyloxazole moiety in the main chain.

1.3 Scope of the research

1. Preparation of monomers containing 2,5-diphenyloxazole by following synthetic steps:
   - 1.1 Synthesis of benzoyl cyanide
   - 1.2 Cyclization reaction of benzoyl cyanide with benzaldehyde
   - 1.3 Coupling reaction 4-bromo-2,5-diphenyloxazole with tributyl(vinyl)tin
2. Preparation of polymers containing 2,5-diphenyloxazole via polymerization of methyl methacrylate (MMA) and 2,5-diphenyl-4-vinyloxazole monomers
3. Preparation of polymers containing 2,5-diphenyloxazole via polymerization of methyl styrene and 2,5-diphenyl-4-vinyloxazole monomers
4. Characterization of polymers
5. Determination of the optical properties of both polymers and 2,5-diphenyl-4-vinyloxazole