UNIVERSITI TEKNOLOGI MARA

DEVELOPMENT OF DISSOLVED OXYGEN OPTICAL FIBER SENSOR USING AN ORGANICALLY MODIFIED SILICATE (ORMOSIL)

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ABSTRACT

An organically modified silicate (ORMOSIL) sol-gel technique has been proven can enhance the luminescence of dissolved oxygen (DO) optical fiber sensor. The n-propyltriethoxysilane (n-propyl-triEOS) and ruthenium are selected as an organic modifier. The absorption spectrum of the sensitive dyes of ruthenium, platinum and palladium are reflect to emission intensity of the dyes. Sol-gel fabrication parameters such as solvent, catalyst, and dye concentration are varied in order to investigate the effect on fluorescence emission intensity of the DO optical fiber sensor. Furthermore, the effect on fluorescence performance of plastic optical fiber (POF) and plastic clad fiber (PCF) are also studied. The dip immersion technique is chosen to coat film on the optical fiber. Resulting film properties like thickness, surface roughness and withdrawal speed rate on a glass substrate and on optical fiber are discussed. In addition, sensor performance characteristics such as sensitivity, responsitivity, and hysteresis of DO optical fiber sensor tested in the air, deionized water and seawater are described.

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INTRODUCTION

1.1 INTRODUCTION

This chapter describes about the general overview, problem statement, objectives and dissertation organization of this research study.

1.2 GENERAL OVERVIEW

The determination of dissolved oxygen (DO) concentration is one of major importance parameters in aquaculture[1][2][3]. The DO is a relative measure of the amount of oxygen , dissolved in a water solution which indicates the quality of both fresh and salt water aquaculture ponds. At 20 °C and 1 atm pressure the maximum oxygen concentration in water is 9.2 ppm [4]. In any circumtances, most of the aquaculture inhabitants can hardly survive whenever the dissolved oxygen concentration drops under 5 ppm. There are a variety of factors that can decrease the level of dissolved oxygen in water. For example, plant and algae need oxygen to respire at night. Two weather factors, temperature and barometric pressure, can also affect levels of dissolved oxygen. As temperature increases, water tends to hold less dissolved oxygen so dissolved oxygen levels in water tend to decrease when it is warmer. And when it is cooler dissolved oxygen levels tend to increase. Also, as barometric pressure increases, the solubility of oxygen increases so levels of dissolved oxygen tend to increase.

Conventionally, there are two widely used methods to measure DO concentration; the electrochemical and the Winkler method[4][5][6][7]. The electrochemical method, also known as Clark electrode method, is capable to give a quick response. However, the method will consumes the oxygen of the sample and can easily get corroded. Meanwhile, the Winkler method requires large sample volumes and much lower lifetimes. This method also has a complicated procedure and can only be operated by a trained personnel. This will result in additional cost for the aquaculture ponds operators and it is prone to human error. This detection method is