CHAPTER I
INTRODUCTION

Dye-sensitized solar cells (DSSCs) have been studied and received attention for several years because of their practical qualities; they are more flexible, renewable, lightweight and low-cost than silicon traditional solar cells. DSSCs are one type of the photovoltaic devices for conversion of the sunlight into electricity. The first DSSC was successfully produced by O'Regan and Grätzel in 1991. However the conversion efficiency of the DSSCs (conversion efficiency ~11%) was much lower than that of the silicon solar cells (~33%)

The principle operation of DSSCs is similar to the photosynthesis in the use of dye as the light harvester. The DSSC consists of wide bandgap of semiconductor on the conductive glass, sensitized dye, redox electrolyte and counter electrode. Also DSSC can be divided into two types depend on types of dye: synthetic DSSC and natural DSSC. The highest efficiency of natural DSSC of 1.26% was fabricated by Calogero *et al.* in 2010 with red turnip based on TiO_2 semiconductor. For synthetic DSSC, TiO_2 with black dye which was produced by Chiba *et al.* in 2006 had been reached the highest conversion efficiency equaling to 11.1%. To compensate alternative TiO_2 semiconductor, ZnO was chosen due to it has similar band gap to TiO_2 and its electron mobility is higher than TiO_2.

Over the last few year, quantum dots (QDs) have widely studied thanks to their properties. First of all, when they absorb the sunlight with higher energy than their bandgap, they can generate more than two electrons from the single photon (electron-hole pair) (Sambur *et al.*, 2010). Moreover, QDs have high surface area and porosity as the same as semiconductor.

The main problem that results in the low conversion efficiency of the DSSCs is the interaction between ZnO and natural dye. Furthermore, light absorption band of natural dye is narrow. According to those problems, the optical properties and absorption mechanism of some natural dye were studied. In order to get broad light absorption, two natural dyes were mixed together. Moreover, quantum dots (QDs) which were produced on semiconductor were used to increase light absorption

capability of DSSC. Consequently, a greater power conversion efficiency of DSSC can be expected.

Therefore, this study has focused on an investigation of ZnO/mixed natural dyes/QDs used as a photoanode for DSSC. The ZnO film was fabricated by doctor-blading method. The extracted natural dyes have been employed as a sensitizer. The QDs were produced by chemical bath deposition method (CBD). The crystal structures of ZnO and QDs were identified by X-ray diffraction (XRD). The surface morphologies were studied by field emission scanning electron microscopy (FE-SEM). The optical property of electrode was measured by UV-Vis spectrophotometer. The absorption mechanism was studied by Fourier transform infrared spectrometer, under both kinetic batch study and isothermal study. The photovoltaic properties were determined by a digital Keithley 2400 multimeter.