CHAPTER I

INTRODUCTION

At present, the main resource of energy is fossil fuel. Combustion of fossil fuel liberates greenhouse gases causing global warming and environmental damage. Increasing of the world population leads to high demand of fossil fuel consumption accordingly. Thus, finding an alternative renewable and clean energy resource is inevitable [1].

The sun is a clean and never run out energy source. The energy consumed by humans annually equal to the energy from solar irradiation strikes the earth in just 10 minutes [2]. For this reason, the solar energy is one of the best solutions of our energy problems.

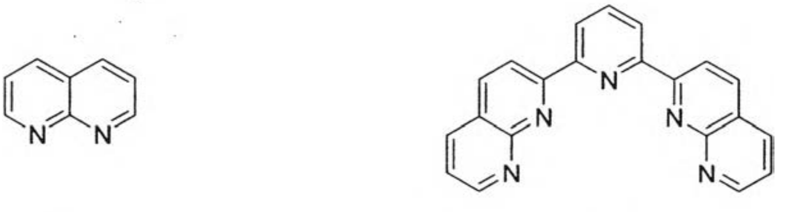
Optoelectronics is the study and application of electronic devices that interact with light. Optoelectronic devices interconverse light and electricity directly. Devices such as phototransistors, photodiodes and laser diodes convert electricity to light and devices such as optical sensors, solar cells convert light to electricity [3].

Solar cells are divided into inorganic and organic solar cells. Inorganic solar cells made from semiconductor such as crystalline and amorphous Si, CdTe and $CdIn_{1-x}Ga_xSe_2$ thin film [4]. Currently, the cells exhibit high efficiency but, in fact, high-technology production is required in high cost and a desirable trade-off can be made between the reduced thickness of the semiconducting layer (reducing cost) and an inevitable reduction in efficiency, due to the limited crystalline quality of the thin film [5]. Thus, organic solar cells, such as dye sensitize solar cell and bulk heterojunction solar cells have been of intensive interest because of advantage of organic materials is the ability to produce devices using solution phase techniques, such as ink jet printing or various roll to roll techniques, which could lead to very cheap, high through put manufacturing. Additionally, organic solar cells have high absorption coefficients which allow very thin films to be used [5].

One of the most important parts of dye sensitized solar cells is photosensitizer. Photosensitizer is a molecule that absorbs photon and initiates change in a system. Photosensitizer is a key for high photoelectrical conversion efficiency which depends upon absorptivity of the molecule. This research aims to design a new molecule is used as an alternative photosensitizer.

The 1,8-naphthyridyl ligands (**Figure 1.1** (a)) have been studied in the field of optoelectronics, especially as photosensitizers, for decades [6-9]. One of the popular approaches to enhance the cell efficiency can be achieved by extending the π-conjugation system in the molecule.

Bis-naphthyridyl pyridines (**Figure 1.1** (b)) are polydentate derivatives of 1,8 naphthyridines with extended π-conjugation. Some metal complexes of bis-naphthyridyl pyridines showed interesting electrochemical properties [10] and also exhibited catalytic activities for water oxidation [11].



(a) (b)

Figure 1.1 Structures of (a) the 1,8-naphthyridyl and (b) bis-naphthyridyl pyridine ligands

This research described the synthesis of bis-naphthyridyl pyridine derivatives with a carboxyl group at the 4-position on the central pyridine ring and its Ru(III) complex (**Figure 1.2**) for possible use as an alternative photosensitizer.

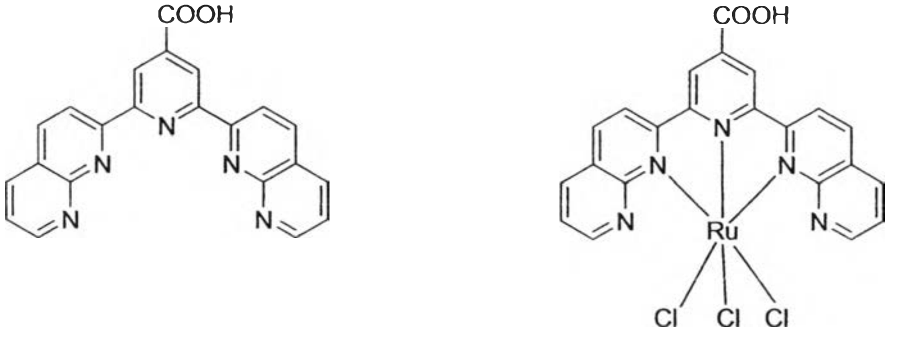


Figure 1.2 Structures of the target molecules

1.1 Objectives of this research

1.1.1. Synthesis and characterization of a novel bis-naphthyridine derivatives.

1.1.2. Investigation of the photophysical properties of the bis-naphthyridine ligand and its Ru(III).

1.2 Scope of this research

The scope of this research covers the synthesis of a bis-naphthyridyl pyridine derivative bearing a carboxyl group at the 4-position on the central pyridine ring and complexation of this ligand with Ru(III). The characterization of the new ligand and its complex includes mass spectrometry, infrared spectroscopy and ^{1}H-NMR and ^{13}C-NMR spectroscopy. The investigation of the photophysical properties includes UV-Visible and fluorescence spectrophotometry.