# CHAPTER I

# INTRODUCTION

## 1.1 Statement of purpose

Gases are used for many applications in human life such as fuel, medical applications, and starting materials for production. Although many gases are useful, some of them are hazardous. Exposure to 1000 ppm acetone for 1 hour caused irritation of eye and throat. Ineffectiveness of delivering oxygen to bodily tissues can be caused by carbon monoxide at as low as 667 ppm. Single inhalation of hydrogen sulfide over 1000 ppm caused immediate collapse with loss of breathing [1]. In most cases, users do not know when gases leak, especially explosive and highly flammable gases at petroleum refinery, LPG or NGV in cars and trucks, and toxic gases from factories. Therefore, it is critical to be able to detect the leakage of these gases.

Gas sensor has been developed for a long time. Low cost, long lasting, and quick responses to target gas are good characteristics for good gas sensor. Metal oxide semiconductor is one of materials that achieve these characters. ZnO, $TiO_2$, $SnO_2$, and etc. have been reported as sensing materials for gas detection [2-6].

Metal oxide semiconductor must be activated to be used as sensing materials. Conventionally, heating is required to activate these sensors. It has been reported that temperature at 200-500 °C were used to activate metal oxide semiconductor [7-12]. However, UV light with proper wavelengths can also activate the metal oxide semiconductor to make it possible to operate the sensor at room temperature [13-17]. That is crucial for the detection of explosive gases.

Many research groups have reported that high sensing performance of metal oxide semiconductors relies on surface-to-volume ratio [18-25]. Nanopattern with the smaller particle sizes exhibited the higher surface-to-volume ratio than the large one, as Fan *et al*. reported [22]. One of many processes to achieve the sensing materials with high surface-to-volume ratio is an electrospinning method. Kim *et al*. reported that electrospun $TiO_2$ nanofibers with hot-pressing process exhibited 4 times higher surface-to-volume ratio than conventional electrospun nanofibers [23]. Thus, metal oxide semiconductors which are fabricated via electrospinning method and then hot-pressed is interesting to be used as sensing materials for gas detection at room temperature.

## 1.2 Research objective

To obtain UV-activated electrospun $TiO_2$ nanofibers as gas sensor at room temperature.

## 1.3 Research scope

1.3.1 Design and assembly of the gas chamber

1.3.2 Preparation of electrospun $TiO_2$ solution

1.3.3 Fabrication of electrospun $TiO_2$ nanofibers via electrospinning process

1.3.4 Characterization of electrospun $TiO_2$ nanofibers to investigate morphology, crystal structure, and surface area by techniques which are SEM, XRD, BET, and contact angle measurement

1.3.5 Electrical characterization of electrospun $TiO_2$ nanofibers to indicate sensitivity, selectivity, and life time of fabricated sensor