CHAPTER 5

CONCLUSIONS AND SUGGESTIONS

5.1 Conclusions

In this thesis, the NPs were successfully synthesized by 2 ways are a novel sparking process and pyrosol method. Ti wire was chosen as a precursor to synthesize a colloidal TiO_2 NPs by sparking process. The research objective was focused on the particle sizes, the sparking mechanism, the effect of sparking time on the NP concentrations, morphology, annealing effects, structural, optical properties and also photocatalytic and antibacterial activities. Fe (III) nitrate was chosen as a precursor to synthesize Fe_2O_3 NPs by pyrosol method. In this work, the research objective was focused on the effect of precursor concentrations on the particle size, morphology and structural properties.

5.1.1 Photocatalytic activity of colloidal TiO_2 NPs prepared by sparking process

In summary, anatase TiO_2 NPs were successfully prepared by sparking process at a concentration rate of 0.74 mg/h. The primary particle sizes in the range of 1-5 nm were obtained. The structural properties from SAED patterns and Raman spectra shows the as-deposited sample was anatase phase and anatase-rutile phase transformation was observed from the samples at annealing temperature as below as 500 °C. The optical properties of the samples show the energy gap higher than bulk TiO_2. The methylene blue-decoloration testing under sunbath suggests that the

colloidal TiO_2 NPs prepared by this present work have good photo-catalytic property. Thus, we suggest that the sparking process can be used to prepare many other colloidal metal/metal-oxide NPs.

5.1.2 Antibacterial activity of colloidal TiO_2 NPs prepared by sparking process

In the case of antibacterial activity, the results have shown that the percentage of survival rate of *E.coli* which reacted with TiO_2 under UV light was rapidly decreased from 20 to 0% within 1 h of the reaction time. However, the survival rate of *E.coli* which reacted with TiO_2 in the dark have shown significant antibacterial activity due to small size of NPs probably migrate through *E.coli* cells in the dark which can also lead to the cell death at longer reaction time.

5..1.3 Synthesis of Fe_2O_3 nanoparticles by pyrosol method

In summary of this research section, iron oxide nanoparticles were successfully synthesized from the aqueous iron nitrate solution by the simple and low cost pyrosol technique. The spherical and uniformly particle sizes increased with increasing of the precursor concentration. The experimental result is in good agreement with the theoretical relation in which the particle size is related to the third root of the precursor concentration. The XRD peaks from the as-prepared samples are corresponding to the α-Fe_2O_3 phase.

5.2 Suggestions

5.2.1 According to the sparking process is a very simple method to synthesis of metal oxide NPs and also NP thin films. Thus, this method can be synthesized some metal oxide for their application, such as indium tin oxide for transparent films, ferrite oxide films and silver NPs for magnetic and antibacterial applications.

5.2.2 According to the sparking process concerned with an electrical energy. Thus, the effect of some properties of metal such as melting point, liquid phase surface tension, density and viscosity of metal on the particle sizes should be studied.

5.2.3 According to this thesis concerned with photocatalytic properties of TiO_2 NPs. Further work, Fe_2O_3 doped TiO_2 should be studied to improved the photocatalytic activity.

5.2.4 According to the pyrosol technique is a very simple method and very easy to control the particle sizes. To synthesize the NPs which are smaller than this work, the precursor concentrations should be decreased.

5.2.5 The advantage of the sparking process is the obtained NPs very small and uniform sizes. Moreover, the crystal phase of the as-prepared sample is crystalline while the other synthesis techniques are amorphous phase.