

## Synthesis of Cobalt Ferrite Particles by Utilized Sol-Gel Method

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**Abstract.** Cobalt ferrite (CoFe<sub>2</sub>O<sub>4</sub>) nanoparticles were successfully synthesized by utilized sol gel method with controlled pH and temperature solution during reflux process in order to obtain monodispersed nanoparticles with high magnetic properties. The obtained cobalt ferrite particles are oval with the size vary from 100 nm to 220 nm. The Co-O and Fe-O bonds are formed as confirmed by FTIR measurement. The sample has high quality crystal with spinel structure as indicated by similar XRD pattern of the sample and the JCPDS (00-001-1121) data without impurity peaks. From the Vibrating Sample Magnetometer (VSM) measurement, magnetic remnant around 0.2303 emu/cc and coercive field around 2.7039 kOe are obtained.

### Introduction

Nanoparticles are one of the important research interests in science and technology due to their advantages in surface chemistry effects. By preparing samples in nanoparticles, some magnetic properties can be improved due to the increase of particles volume ratio [1]. One of the interesting materials for magnetic applications in nanoparticles form is cobalt ferrites. Cobalt ferrites (CoFe<sub>2</sub>O<sub>4</sub>) are well-known magnetic ceramics used in electrical equipment and microwave devices. For biomedical applications, CoFe<sub>2</sub>O<sub>4</sub> should posses high magnetization values and superparamagnetic behavior at room temperature [2-7]. Cobalt ferrites can be synthesized by various methods such as solid state reaction, microemulsion, chemical co-precipitation, hydrothermal method, microwave synthesis and sol-gel method [8]. The sol-gel method is a simple method for preparing cobalt ferrite nanoparticles. In the previous work, we have successfully synthesized cobalt ferrite particle by sol gel method, resulted particles in sub-micron size in the range of 171 up to 405 nm [9].

In this work, we prepared cobalt ferrite particles by sol-gel method with controlled pH and temperature solution during reflux process in order to obtain monodispersed nanoparticles with high magnetic properties.

### Experimental Method

The raw materials of cobalt (II) acetate tetrahydrate, Co(CH<sub>3</sub>COO<sub>2</sub>)<sub>2</sub>·4H<sub>2</sub>O of 1.2454 grams and iron (III) nitrate non ahydrate, Fe(NO<sub>3</sub>)<sub>3</sub>·9H<sub>2</sub>O of 4.0400 grams were dissolved in 47 ml of 2-methoxyethanol and stirred for 3 h without heating. Diethanolamine was added droply wise until the solutions reached pH of 9.5 and refluxed at 125 °C for 13 h. The persent mol composition of Co<sup>2+</sup>: Fe<sup>3+</sup> is 33%:67%, while molar composition of 2-methoxyethanol and diethanolamine is 1:3. After 24 h, the solution was filtered and centrifuged at 5000 rpm for 15 minutes to obtain the fine particles. The particles were redispersed in 2-methoxyethanol. The