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Preparation of Nano Ink Using Cobalt Ferrite and Barium Titanate for Printed Electronic Devices

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***Abstract*: Lead in our body is toxic and hazardous. Here lead-free Cobalt ferrite and Barium Titanate inks have been prepared and fabricated. The prepared inks remained stable without agglomeration or condensation during preservation. Cobalt Ferrite and Barium Titanate Nano inks have been characterized using X-ray diffraction method and UV Visible Spectroscopy. By the analysis of X-ray diffraction (XRD), the resultant inks were confirmed to be of pure Cobalt Ferrite and Barium Titanate powders with cubic structure and tetragonal structure respectively. Lattice parameters and grain size have been determined by X-ray diffraction method. UV Visible Spectroscopy analysis has been done to obtain the band gap energy of the prepared inks. The preparation and characterization of Cobalt Ferrite and Barium Titanate Nano inks are comprehensively demonstrated in this paper.**

***Keywords*: Barium Titanate Nano ink, Cobalt Ferrite Nano ink, Inkjet printing.**

1. Introduction

Usage of pigments containing lead in printing inks is widespread and is a common practice. The coloured pages of almost all newspapers and magazines contain high levels of lead. If we burn these papers containing lead, then this may result in air pollution and severe health problems like anaemia, weakness, kidney and brain damage in humans. Even small amounts of lead in the body are harmful. So there arises a need for having lead-free pigments in inks. Nanoparticles have more amplified properties than bulk solids. By making use of these properties in the ink industry we can make inks having more enhanced properties than that are available today. Such inks are called Nano inks. The size of the pigment used in making ink plays a major role. Their size can significantly affect the colour, strength and durability of the final product. Smaller the pigment size better will be the ink. Also, the particle size of the pigments must be small enough so that they do not block the nozzles of the printing mechanism. Decreasing the particle size will increase the stability of the ink. The colour of the ink depends on the pigment used and the particle size of the pigment governs the intensity of the ink colour. Thus we can see that Nano-sized particles can enhance the properties of the ink. This paper reports the preparation of Cobalt Ferrite and Barium Titanate Nano inks which are lead-free and cost-effective.

2. Materials and Methods

A. Cobalt Ferrite

Cobalt Ferrite is having inverse spinel structure. The magnetic properties such as saturation magnetization, remnant magnetization, coercivity and Curie temperature of Cobalt Ferrite at high temperatures are the same as at room temperature [1], [2].

B. Barium Titanate

This is an inorganic compound with the chemical formula $BaTiO_3$. $BaTiO_3$ is a ferroelectric ceramic material. They possess polarization in the absence of an electric field [2]. This is a white powder and transparent as larger crystals. It has ABO3 type perovskite structure. The cubic form of BaTiO3 is non-polar. By decreasing temperature below 120°C, spontaneous polarization occurs in $BaTiO_3$ and the crystal goes through a phase transition to the ferroelectric state. In this process, the cubic structure transforms to tetragonal. In the tetragonal form refractive index is independent of temperature. Barium Titanate is insoluble in water. Lead-free $BaTiO_3$ remains attractive for environmental reasons [3]. Being a lead free ferroelectric ceramic, it is a good candidate for ink making.

C. Synthesis of Cobalt Ferrite nanoparticles

The sol of Cobalt Ferrite was prepared by a simple sol–gel method incorporating the nitrates of cobalt and iron (3+). Sol-gel is a chemical solution process used to make ceramic ink pigments and glass materials in the form of thin films or powders. A mixture of ethylene glycol and ethanol taken in the ratio 1:1 was used as the solvent and mixed with the nitrates of cobalt and iron (3+)[4]. The mixture was stirred until the gel was formed. The gel was dried in air at room temperature. The resulting solids were then ground and sieved to get fine powder which was annealed at 850°c for 3 hours.