INVESTIGATION AND PREPARATION OF CERAMIC INK BY THE SOL-GEL METHOD

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1. ABSTRACT

As we have seen, today digital inkjet decoration has been widely adopted in Europe, where it has become the essential technology for ceramic tile manufacturers, and is now also growing rapidly on other continents. However, its success did not come overnight.

This project includes two steps: first involves producing the pigment and the second is synthesis of the digital ink.

Firstly, we have synthesized cobalt alumina ($CoAl_2O_4$) nano powders as blue pigments by the combustion sol-gel method, in which $CoSO_4.7H_2O$ and $Al(NO_3)_3$ were used as precursor materials and a mixture of urea and glycine as fuel. The presence of $CoAl_2O_4$ phase was confirmed by XRD. In the next step we focused on ink synthesis, in which the blue pigment which was synthesized in the first step, a surfactant and an organic solution as a medium for dispersing the pigments were used. CTAB (cetyltrimethylammonium bromide) was chosen as a surfactant and ethylene glycol was used as an organic solution which pigments could be dispersed in CTAB.

2. INTRODUCTION

Just over a decade ago, the only way to decorate ceramic tiles was using traditional printing methods, the most common of which was screen printing and the industry as a whole had little use even for computers. It was difficult for manufacturers to make their tiles stand out from the competition and be differentiated. For ceramic tile decoration, the first major advantage of digital inkjet is that it is a non-contact process. Another is creative benefits such as there being no roller; the third is a faster set-up and the last one is rapid payback- in less than six months. Due to these factors, producing digital ink for inkjet is on the rise.

It is vital to have a good understanding of the ink composition. All printing inks are composed of four types of ingredients: 1. Colorant, 2. Binder, 3. Solvent, 4. Additives.

In this paper, we have synthesized digital ink based on Co-Al for ceramic tiles which is used in inkjet printers. $CoAl_2O_4$ spinel is used as pigment or colorant in this ink.

3. EXPERIMENTAL

3.1. SYNTHESIS OF NANO-$COAL_2O_4$ CERAMIC PIGMENT

The nano-$CoAl_2O_4$ powder was prepared through the combustion method using cobalt sulfate and aluminium nitrate as a source of cobalt and aluminium respectively. Urea and glycine were added as fuel in combustion.

First cobalt sulfate and aluminium nitrate were dissolved in 100 ml de-ionized water. Then the solution was heated to 80°C and evaporated for 1 hour under magnetic stirring, followed by adding a mixture of urea and glycine to the solution. The product of combustion was calcined at 1000°C.

4. RESULT AND DISCUSSION

4.1. X-RAY DIFFRACTION (XRD)

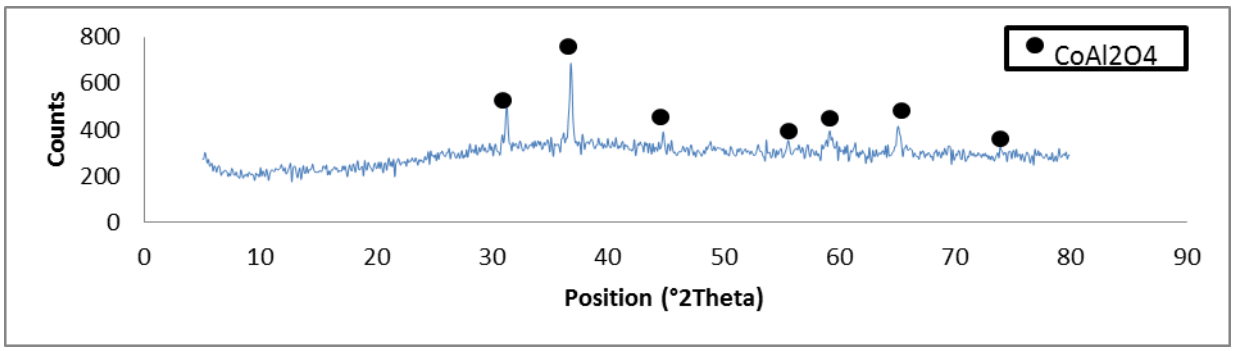

Fig. 1. *The XRD patterns of the nano-$CoAl_2O_4$ particles.*

4.2. SCANNING ELECTRON MICROSCOPE (SEM)

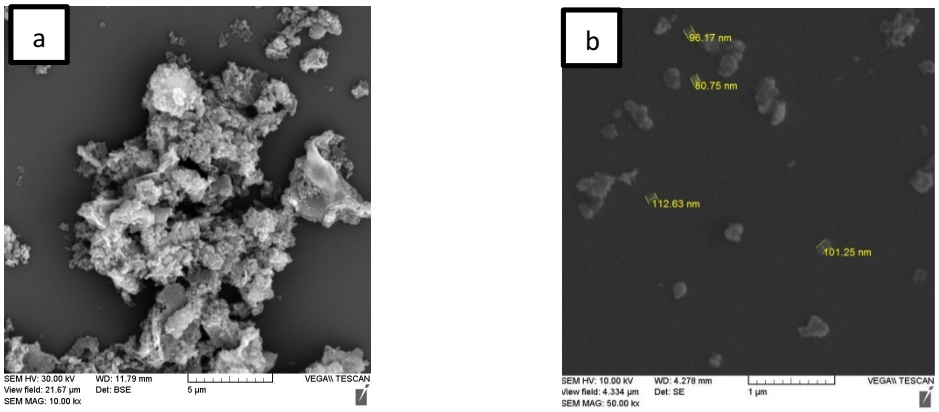

Fig. 2. *(a) SEM of agglomeration of $CoAl_2O_4$ nano-powder (b) SEM images of the nano-ink based on $CoAl_2O_4$.*

4.3. VISCOSITY

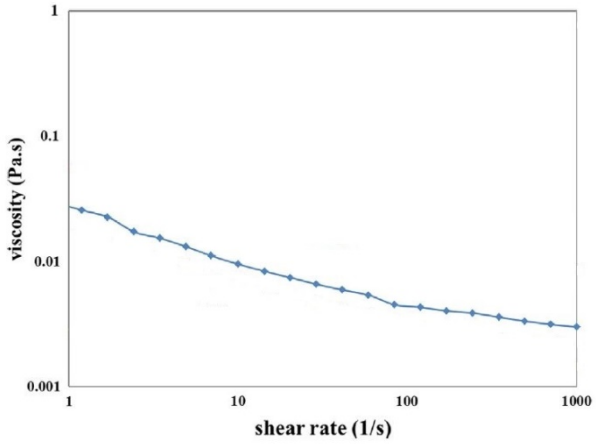

Fig. 3. *Viscosity with shear rate for the prepared ink.*

5. CONCLUSION

In this paper, all in all nano-CoAl2O4 pigments were synthesized through the sol-gel method. The ceramic inks were prepared using cetyltrimethylammonium bromide (CTAB) as surfactant. The pH and viscosity with shear rate were measured.