

## Polymer- stabilized Co Nanocrystals.

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**Abstract** Polymer-coated cobalt nanocrystals were prepared in a polar solvent at high temperature through an organometallic thermal-decomposition route in the presence of poly (N-vinyl-2-pyrrolidone) as a protective polymer. The as-synthesized PVP-coated cobalt nanocrystals were 20 to 80 nm cubic/hexagonal shapes. HCP was further determined as a main phase in these samples. For comparison purposes, we have also prepared PVP-cobalt nanocrystals using the seed-mediated thermal decomposition method. It revealed that PVP plays a significant role in the synthesis of cubic-structured cobalt nanocrystals. It was also noted that the formation of Co nanocrystals and their magnetic properties were dependent not only on the PVP component but also in the synthetic route. The saturation magnetization ( $M_S$ ) determined from the seed-mediated sample is lower than that of the conventional sample. The coercivity of the former (610 Oe at 5 K), however, is double that of latter (300 Oe at 5 K), indicating that coercivity strongly depends on the crystallinity of the cobalt.

### Introduction

Nanostructured transition metal crystals are excellent samples of advanced materials. Their physical properties are highly dependent on the nature of the surface [1]. Interestingly, polymer-coated magnetic nanoparticles also have great potential in many technological fields, including biological and environmental applications. However, only a few groups reported to employ linear polymers in processing magnetic nanoparticles [2, 3]. In this paper, we focused on the synthesis of polymer-coated cobalt nanocrystals and investigated various influences on its magnetic properties. Our research samples were prepared in a polar solvent through organometallic thermal-decomposition at a high temperature, with the presence of poly (N-vinyl-2-pyrrolidone) (PVP) as a protective polymer. Although Sun, et al. has produced PVP-coated FePt nanocrystals [4], in which capping agents (hydrocarbons with short chains such as oleic acid/oleyl amine) were exchanged with linear polymers, our process was different. We directly used PVP as a stabilizing agent and produced the samples in a polar solvent system.

### Experimental Section

All reactions were conducted using standard airless procedures and commercially available reagents. Cobalt octacarbonyl was purchased from Gelest, poly (N-vinyl pyrrolidone) (PVP, Mw  $\approx$  2500) from Polysciences, trioctylphosphine (90 %) from Aldrich, and ethylene glycol (98 %) from EM Science. The reagent grade ethyl alcohol was employed as a solvent.

In a typical synthesis, poly(N-vinyl pyrrolidone) (0.06g), dissolved in 10 mL ethylene glycol, was injected into 16 mL ethylene glycol at 45 °C. This was done under an Ar atmosphere while being agitated vigorously.  $5 \times 10^{-2}$  g of  $\text{Co}_2(\text{CO})_8$  were then added to the above solution at 50 °C. The temperature was steadily increased to 160 °C within 1hr and maintained at 160 °C for an additional 20 min. From a transparent color, it changed into black, indicating the formation of cobalt particles. The reaction mixture was then allowed to cool at room temperature under an argon