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The Coexistence of Superconductivity and Ferromagnetic Phases in $YBa_2Cu_3O_{7-\delta}$ Nanoparticles

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Magnetic properties of superconducting $YBa_2Cu_3O_{7-\delta}$ nanoparticles have been studied. They have prepared by the citrate gel modification of the sol-gel technique [1,2]. Different particle sizes were obtained by calcination of Precursor powder in oxygen atmosphere at 860 (A_1 sample) and 900˚ C (B_1 sample) [3]. After light grinding, the samples were annealed at 700 ˚C for 2 h in flowing O_2 (A_2, B_2). Room temperature magnetizations measured using a vibrating sample magnetometer (VSM) showed that they have weak magnetic properties. The development of ferromagnetism is attributed to the presence of surface oxygen vacancies that lead to electron redistribution on the different ions at the surface. For development of magnetization, the samples were annealed at 700 ˚C for 5 h under 0.8 - 0.9 bar of air ($A_3 \approx 33$, $B_3 \approx 46$ nm). A ccording to x-ray powder diffraction analysis the nanoparticles have orthorhombic structure (Figure 1). The sizes of crystalline were estimated from the width of the (031) XRD peak using the scherrer formula. The ferromagnetic moment increases with decreasing the particle size. You can see M(H) curves of A_2, B_2 samples in Figure 2 and A_3, B_3 in Figure 3 respectively, which clearly indicate that annealing at vacuum improves ferromagnetic properties of the samples (Figure 3).

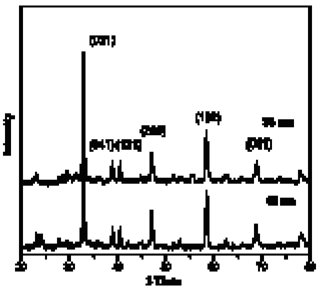

Figure 1. XRD of A_3 and B_3

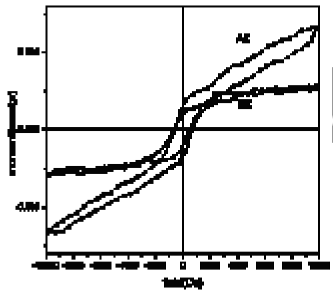

Figure 2. M(H) curves of A_2 and B_2

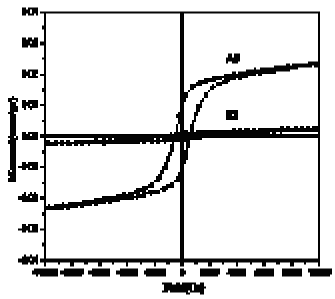

Figure 3. M(H) curves of A_3 and B_3

In nanoparticles, the increasing role of surface defects such as oxygen vacancies may tend to weaken the superconductivity, while the same defects can lead to the development of a ferromagnetic moment in the surface atoms at 300 ˚K. It requires further studies to explore the presence or absence of ferromagnetism in the superconducting state. The observation that room-temperature ferromagnetism occurs in nanoparticles of YBCO is of great interest and has important implications. Surface ferromagnetism in nanocrystalline superconductors may provides a means to study the magnetism in relation to superconductivity of inorganic nanoparticles.

References

[1] X. L. Xu, J. D. Guo, Y. Z. Wang, A. Sozzi, Physica C **371**, 129 (2002).
[2] E. Blinov et al, Supercond. Sci. Technol. **10**, 818 (1997).
[3] S. K. Hasanain, N. Akhtar, A. Mumtaz, Nanopart Reserch, **13**, 1953 (2010).

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Structural and Magnetic Properties of Ni-Ferrite Nanoparticles Which Doped with Cobalt and Manganese

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Because of the wide applications in magnetic ferrite nanoparticles in various areas like. biology, electronic, sensors and etc., there is a growing interest in this materials [1]. In this work, nanoparticles of ($Ni_{0.98}Co_{0.02}Mn_{0.02}Fe_{1.98}O_4$) system were synthesized by sol–gel combustion method at different calcination temperatures and then investigated their physical properties. For preparation of this ferrite, metal nitrates and citric acid (molar ratio was 1:1) were used as the starting materials. And Ammonia was used to adjust the pH value.

Figure 1 shows the XRD patterns at room temperature for the samples, (a), (b) and (c) which calcinated at 500 ºC, 700 ºC and 900 ºC. The Figure 1 illustrates that all diffraction peaks are correspond to cubic spinel structure at 700 ºC and thus the phase was completed at this temperature. By increasing the calcination temperature from 700 ºC to 900 ºC, the right phase of the ferrite is reduced. Also it is observed that with increasing the temperature, nanoparticle size increases (31.92 nm, 41.05 nm and 86.20 nm for (a), (b) and (c) samples respectively). The values of lattice constant of the samples are a little larger than that of for $NiFe_2O_4$. This indicates the incorporation of Co and Mn dopants in the spinel lattice of Ni ferrite, due to larger ionic radius of Co and Mn regarding to Ni. [2,3]. The result of TEM images confirms the XRD's analysis.

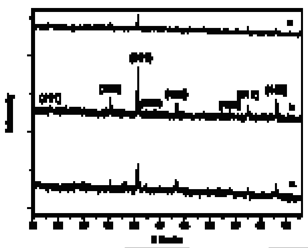

Figure 1. XRD patterns of (a), (b) and (c) samples at room temperature.

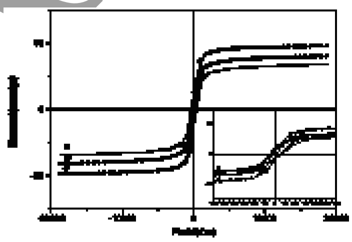

Figure 2. Magnetization curves (a), (b) and (c) samples at room temperature.

Figure 2 presents the results of VSM measurements for the three samples at room temperature. Increasing of the saturation magnetization (M_s) was observed with increasing the temperature (34.07 (emu/gr), 40.42 (emu/gr) and 48.12 (emu/gr) for (a), (b) and (c) samples respectively). The increase in M_s is due to increasing the calcination temperature related to growth of grains. The values of coercivity field (H_c) decrease with the increasing of the calcination temperature (277.75, 250.14, and 115.05 Oe for (a), (b) and (c) samples respectively). When the size of nanoparticles reach to the critical value equal to the size of a single domain, the coercivity decreases because of the changing from single domain to a multi-domain structure [1].

References

[1] M. R. Barati, Sol-Gel Sci Technol. **52**, 171 (2009).
[2] N. Iftimie, E. Rezlescu, P. D. Popa and N. Rezlescu, Optoelectron Adv Mat. **7**, 911 (2005).
[3] L. Satyanarayana, K. Madhusudan Reddy, S. V. Manorama, Sensor Actuat. B **89**, 62 (2003).