crystals

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Article

Supplementary Materials

Structural and magnetic properties of Co-Mn codoped ZnO nanoparticles obtained by microwave solvothermal synthesis

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Materials and Methods

2.2. Synthesis of NPs

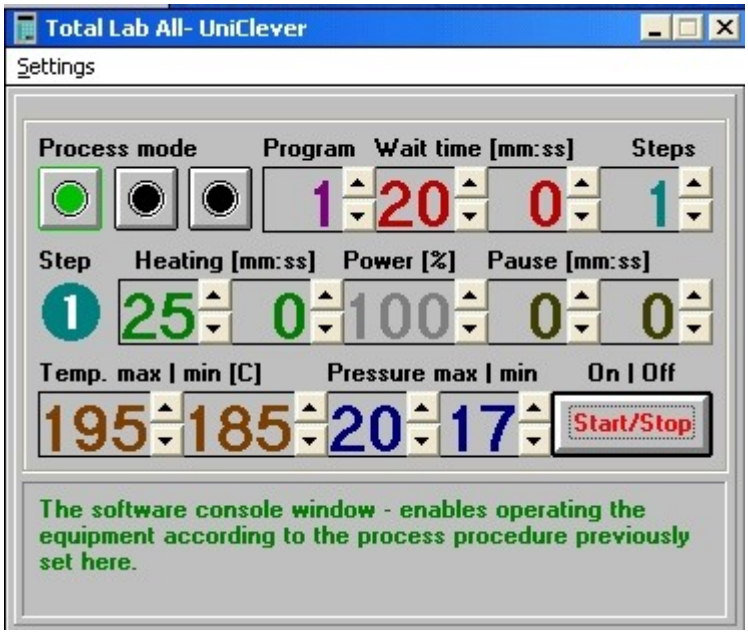

Figure 1. Control panel of the microwave reactor Model 02-02, ERTEC, Poland. Control software: Total Lab All, Version 22-X-2008, ERTEC, Poland.

Results

1. Morphology

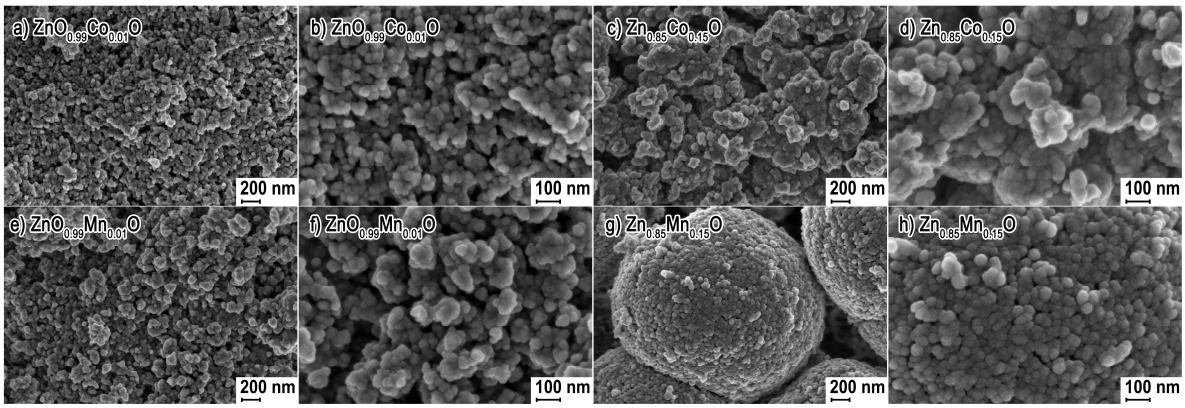

Figure 2. SEM images of NPs: (**a**) and (**b**) $Zn_{0.98}Co_{0.01}O$; (**c**) and (**d**) $Zn_{0.85}Co_{0.15}O$; (**e**) and (**f**) $Zn_{0.99}Mn_{0.01}O$; (**g**) and (**h**) $Zn_{0.85}Mn_{0.15}O$.

3.2 Phase Composition

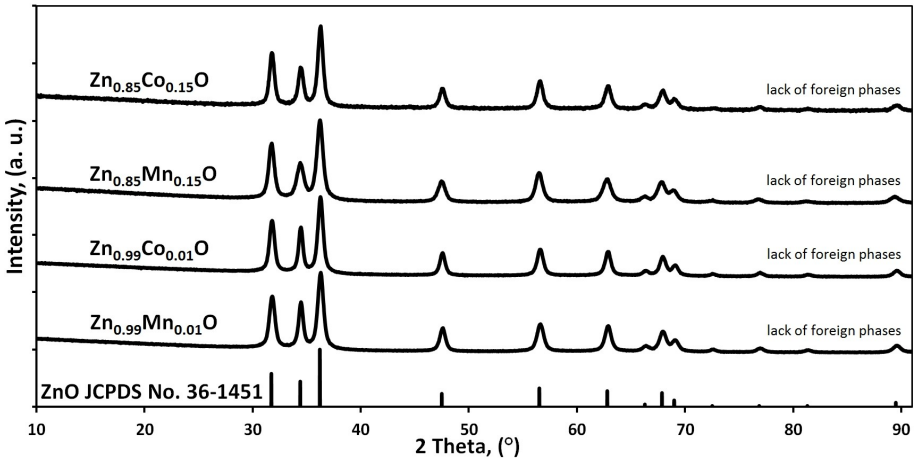

Figure 3. XRD diffraction patterns of $Zn_{(1-y)}Co_yO$ NPs and $Zn_{(1-x)}Mn_xO$ NPs.

3.2 Chemical Composition

Table 1. Results of the analysis of the chemical composition of $Zn_{(1-y)}Co_yO$ NPs and $Zn_{(1-x)}Mn_xO$ samples.

Sample	Actual Dopant Content, mol%					
	EDS			ICP-OES		
	Zinc	Manganese	Cobalt	Zinc	Manganese	Cobalt
$Zn_{0.99}Mn_{0.01}O$	99.73	0.27	X	99,76	0,24	X
$Zn_{0.85}Mn_{0.15}O$	96.35	3.65	X	96.78	3.22	X
$Zn_{0.99}Co_{0.01}O$	99.19	X	0.81	99,23	X	0,77
$Zn_{0.85}Co_{0.15}O$	86.68	X	13.32	87.21	X	12.79

3.3 Density, Specific Surface Area, Size Distribution of NP

Table 2. Characteristic of the NPs samples.

Sample	Specific Surface Area, $a_s \pm \sigma$ (m^2/g)	Skeleton Density, $\varrho_s \pm \sigma$ (g/cm^3)	Average Particle Size from SSA BET, d ± σ (nm)	Average Crystallite Size from Nanopowder XRD Processor Demo, d ± σ (nm)	Average Crystallite Size, Scherrer's Formula, d_a, d_c (nm)
$Zn_{0.99}Mn_{0.01}O$	57.9 ± 0.1	5.17 ± 0.02	20 ± 1	20 ± 6	18_a, 22_c
$Zn_{0.99}Co_{0.01}O$	53.7 ± 0.1	5.22 ± 0.02	21 ± 1	21 ± 7	20_a, 24_c
$Zn_{0.85}Mn_{0.15}O$	46.7 ± 0.1	5.14 ± 0.02	25 ± 1	22 ± 12	15_a,12_c
$Zn_{0.99}Co_{0.15}O$	50.9 ± 0.1	5.18 ± 0.02	23 ± 1	21 ± 7	16_a, 15_c

d—diameter.

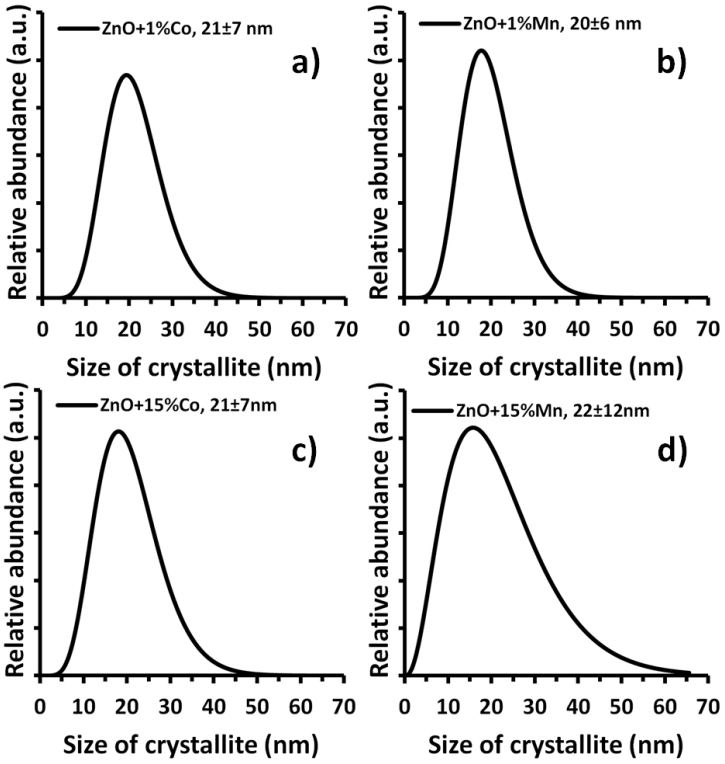

Figure 4. Crystallite size distribution of $Zn_{(1-y)}Co_yO$ NPs and $Zn_{(1-x)}Mn_xO$ NPs: (a) $Zn_{0.99}Co_{0.01}O$, (b) $Zn_{0.99}Mn_{0.01}O$, (c) $Zn_{0.85}Co_{0.15}O$, (**d**) $Zn_{0.85}Mn_{0.15}O$. Data obtained using Nanopowder XRD Processor Demo, pre·α·ver.0.0.8, © Pielaszek Research, http://science24.com/xrd/.