Magnetic Properties of Nanoparticle $La_{0.7}Ca_{0.3}MnO_3$ under High Hydrostatic Pressure

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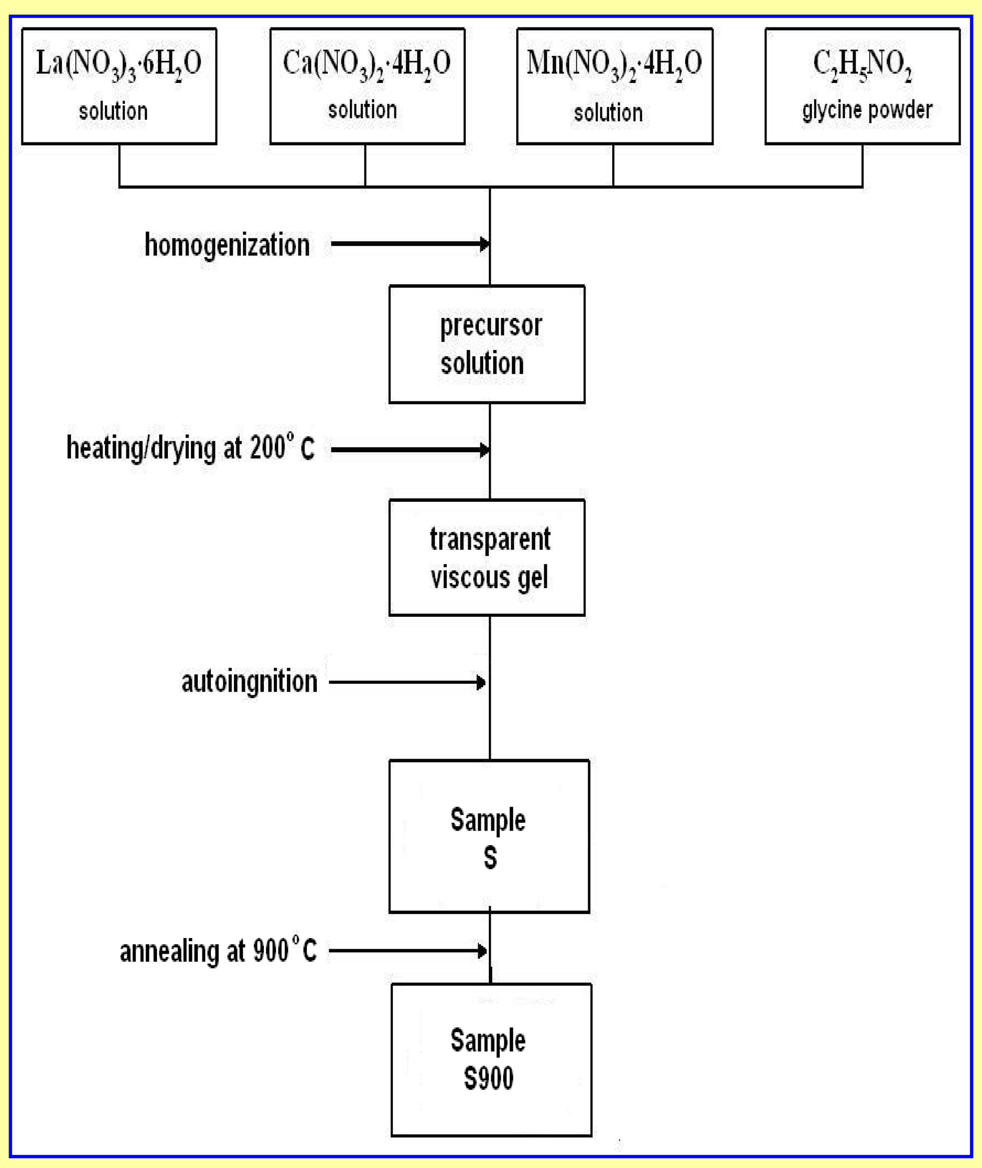
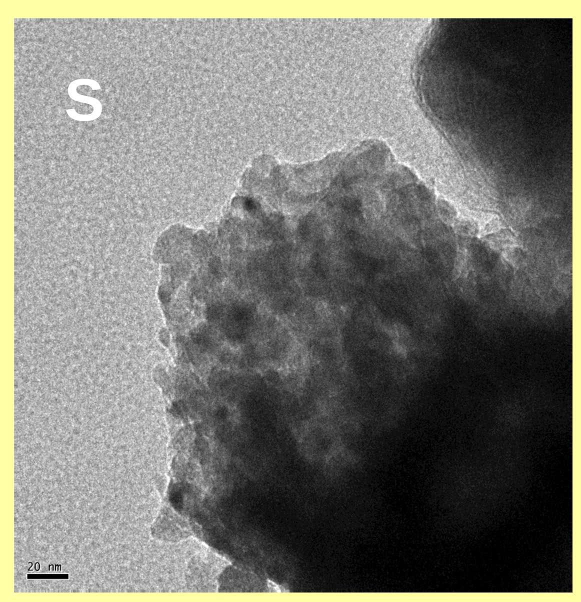
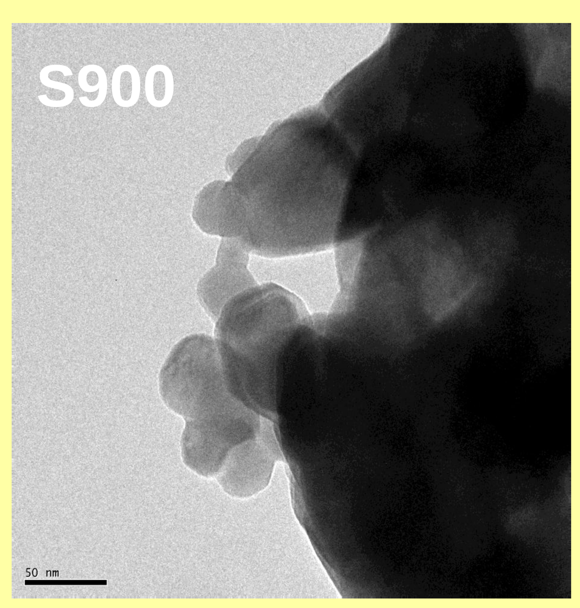
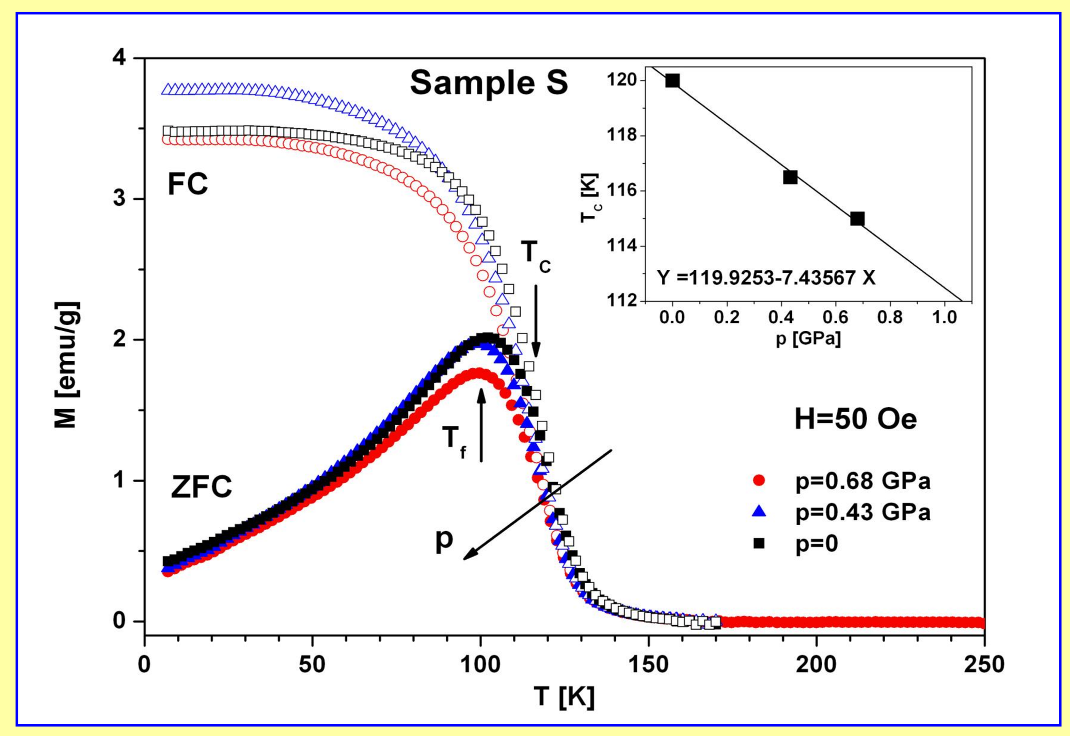
Pressure effect on magnetic properties of two $La_{0.7}Ca_{0.3}MnO_3$ nanoparticle samples with different mean particle size was investigated. Both samples were prepared by the glycine-nitrate method; sample S-as prepared (10 nm), sample S900-subsequently annealed at 900ºC for 2 hours (50 nm). Magnetization measurements revealed remarkable differences in magnetic properties with the applied pressure (up to 0.75 GPa): (i) for S sample both transition temperatures, para-to-ferromagnetic T_C=120 K and spin-glass T_f=102 K, decrease with the pressure with the coefficients -7.5 K/GPa and - 4.4 K/GPa, respectively; (ii) for S900 sample para-to-ferromagnetic transition temperature T_C=253 K increase with pressure with the coefficient 16 K/GPa. At the same time, saturation magnetization M_S recorded at 10 K decreases/increases with pressure for S/S900 sample, respectively. Explanation of these distinctions was proposed within the scenario of the different contributions of nanoparticle surface effects due to the nanoparticle size, and change in unit cell properties of these two samples as a result of the thermal treatment.

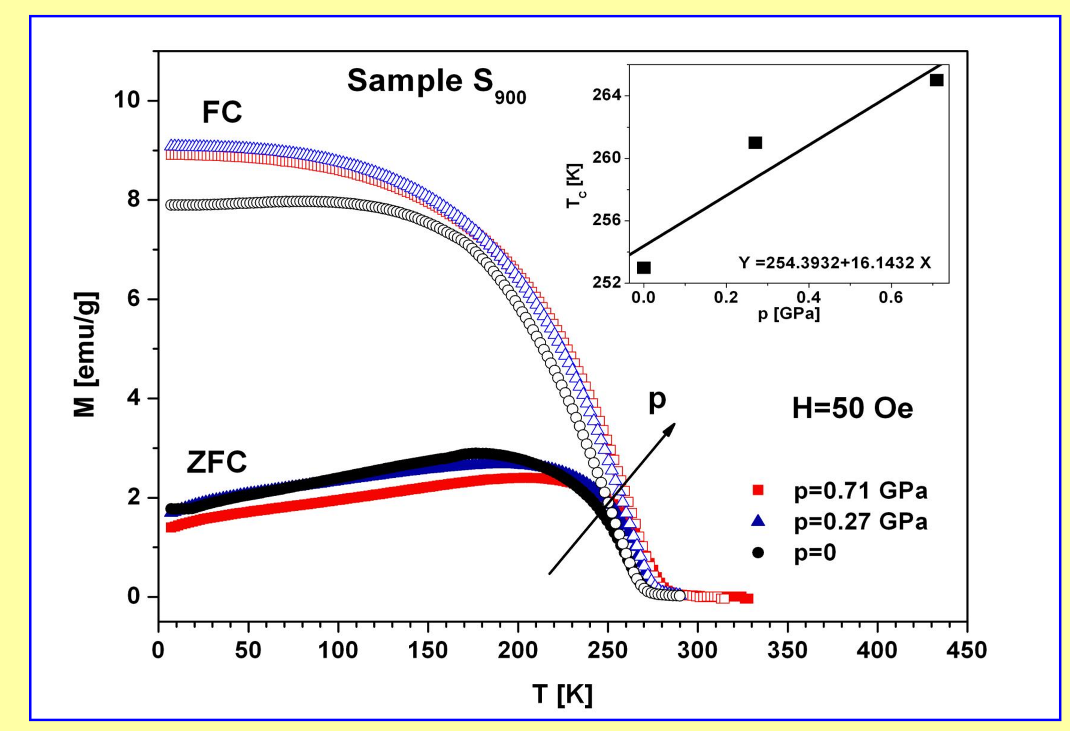
Synthesis route

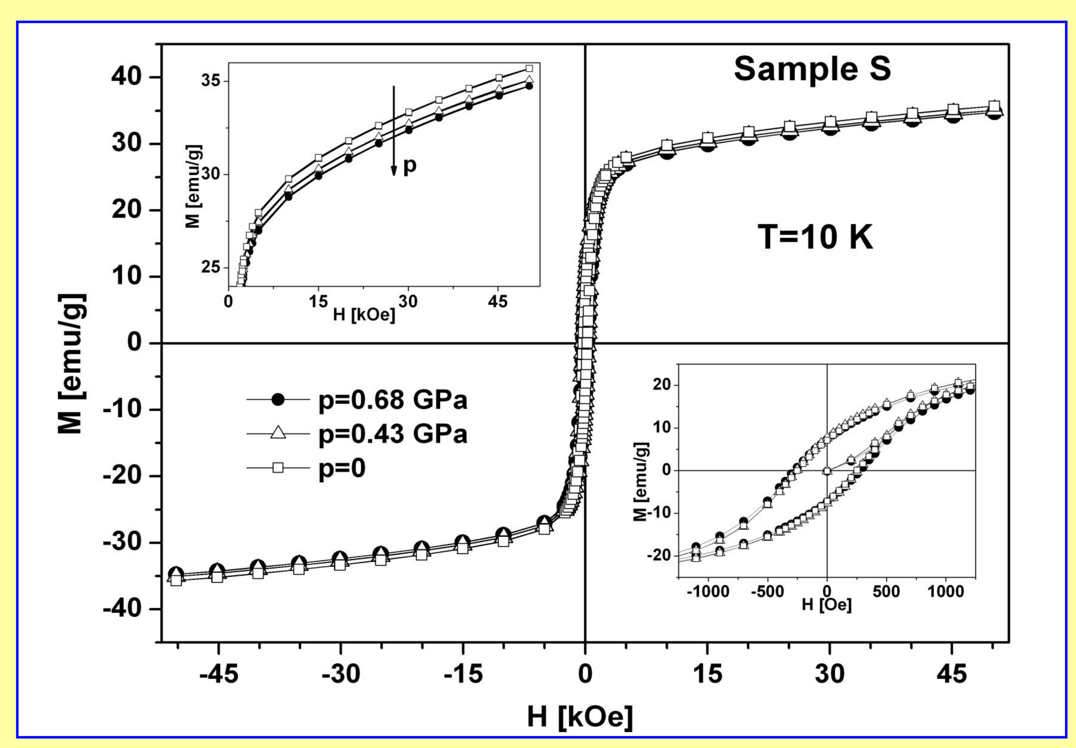


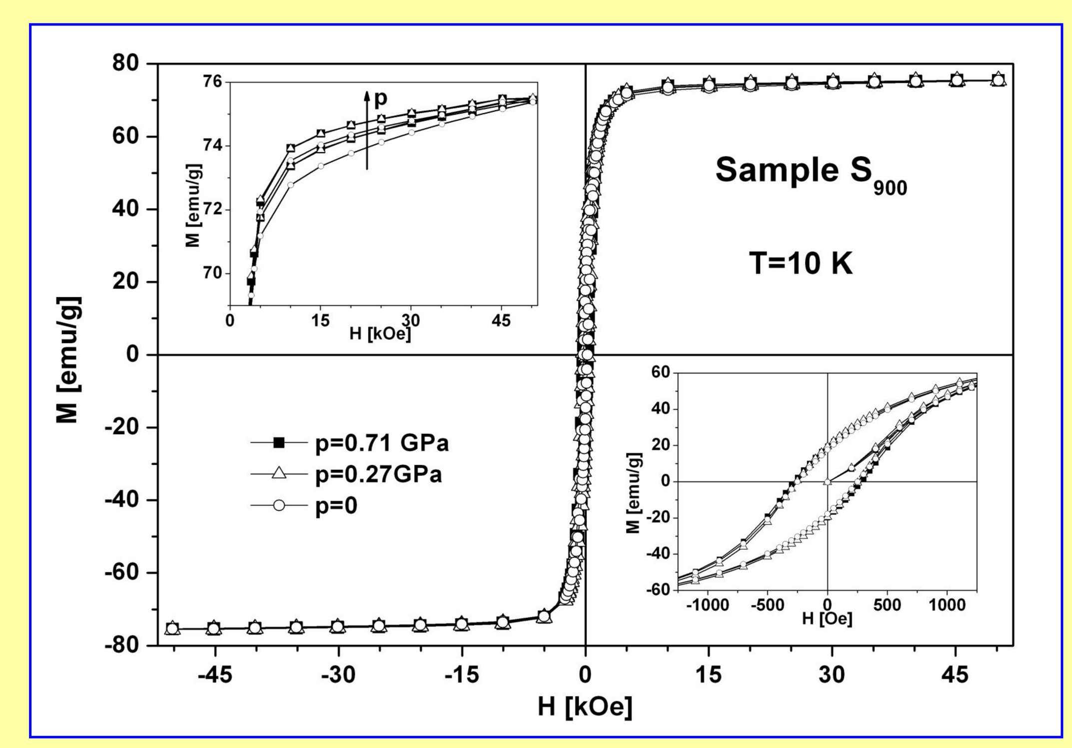


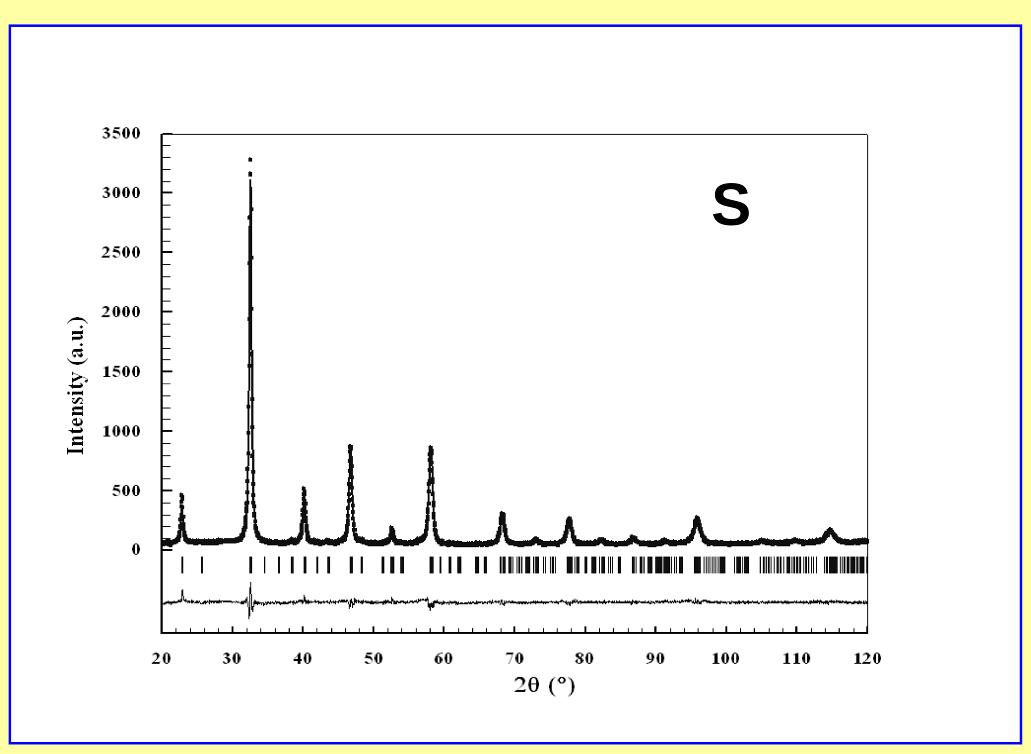


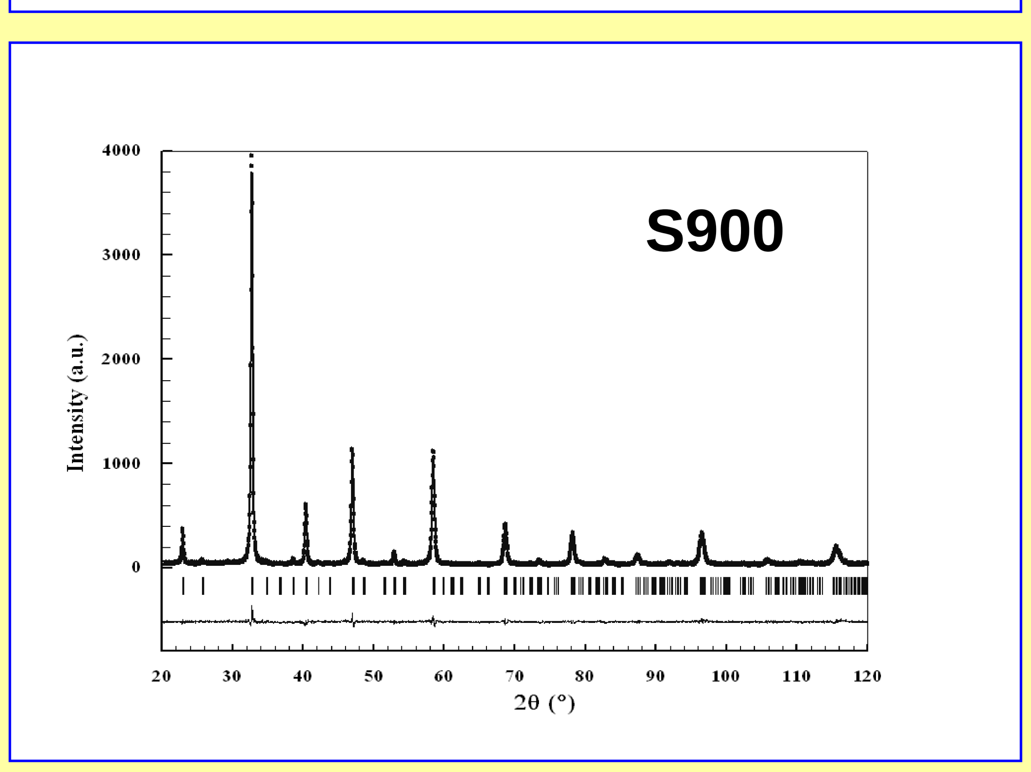












Rietveld refinement: SG P*nma* (orthorombic)

Sample	S	S900
D [nm]	12	49
V [Å³]	234.6	230.9
<Mn – O> [Å]	1.997	1.962
Mn–O1–Mn [ ]	140.3	150.5
Mn–O2–Mn [ ]	162.0	167.4
$\delta_{Jahn-Teller}$*	0.112	0.051
R_{Bragg}	3.81	3.44

$$^{*}\delta_{JT}=\sqrt{\frac{1}{3}\sum_{i}\left[(Mn-O)_i-\langle Mn-O\rangle\right]^2}$$

Magnetic parameters

Sample S	T_C [K]	T_f [K]	H_C [Oe]	M_r [emu/g]	M_S [emu/g]
p=0	120	102	249	7.1	40.5
p=0.43 GPa	116.5	100	261	7.2	40
p=0.68 GPa	115	99	277	7.3	39.5
Sample S900					
p=0	253	-	251	17.7	77
p=0.27 GPa	261	-	257	19.4	78
p=0.71 GPa	265	-	281	19.7	79

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