

Figure S1: Observed, calculated and difference plots for the 'single phase' fit to the neutron powder diffraction data. The expanded region shows the poor fit in the region $45 < 2\theta / ^\circ < 90$. $wRp = 3.86\%$, $Rp = 3.00\%$, $\chi^2 = 3.222$. Refined lattice parameters of LaNiO_2 phase: $a = 3.9610(9) \text{ \AA}$, $c = 3.3816(2) \text{ \AA}$. Refined lattice parameter of nickel impurity : $a = 3.5255(4) \text{ \AA}$.

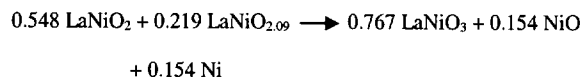
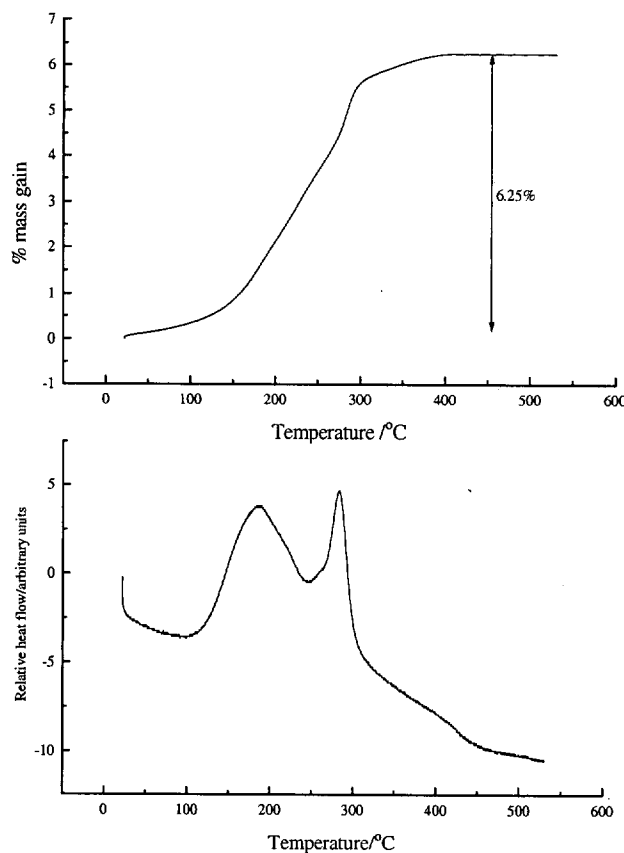


Figure S2: TGA and DSC data showing the reoxidation reaction of $\text{LaNiO}_{2.03}$ under O_2 . $0.077 \text{ La}_2\text{O}_3$ has been omitted from both sides of the equation for clarity. The La_2O_3 is required to satisfy elemental analyses showing the La:Ni ratio of the sample is 1:1, despite no diffraction features assignable to La_2O_3 being observed. (There is no evidence in the Rietveld profile refinement that the LaNiO_{2+x} phases are nickel deficient.)

Phase 1	
Strain parallel to [001]	0.89(4)%
Strain perpendicular to [001]	0.87(2)%
particle size parallel to [001]	78(8)Å
particle size perpendicular to [001]	591(20)Å
Phase 2	
Strain parallel to [001]	2.3(4)%
Strain perpendicular to [001]	0.5(1)%
Particle size parallel to [001]	79(7)Å
Particle size perpendicular to [001]	536(26)Å
Nickel metal	
Strain	1.9(2)%
Particle size	513(90)Å

Table S1: Strain and particle size values evaluated from refined profile coefficients of the majority LaNiO_2 and minority LaNiO_{2+x} phases.