

Supporting Information

Effect of One Step Solid State Reaction Route on the Semiconductor Behavior of the Spinel (Ni, Co, and Mn)O₄ to Be Used as Temperature Sensor

Daehyeon Ko and Sungwook Mhin *

Department of Advanced Materials Engineering, Kyonggi University, Suwon 16227, Korea

* Correspondence: swmhin@kgu.ac.kr

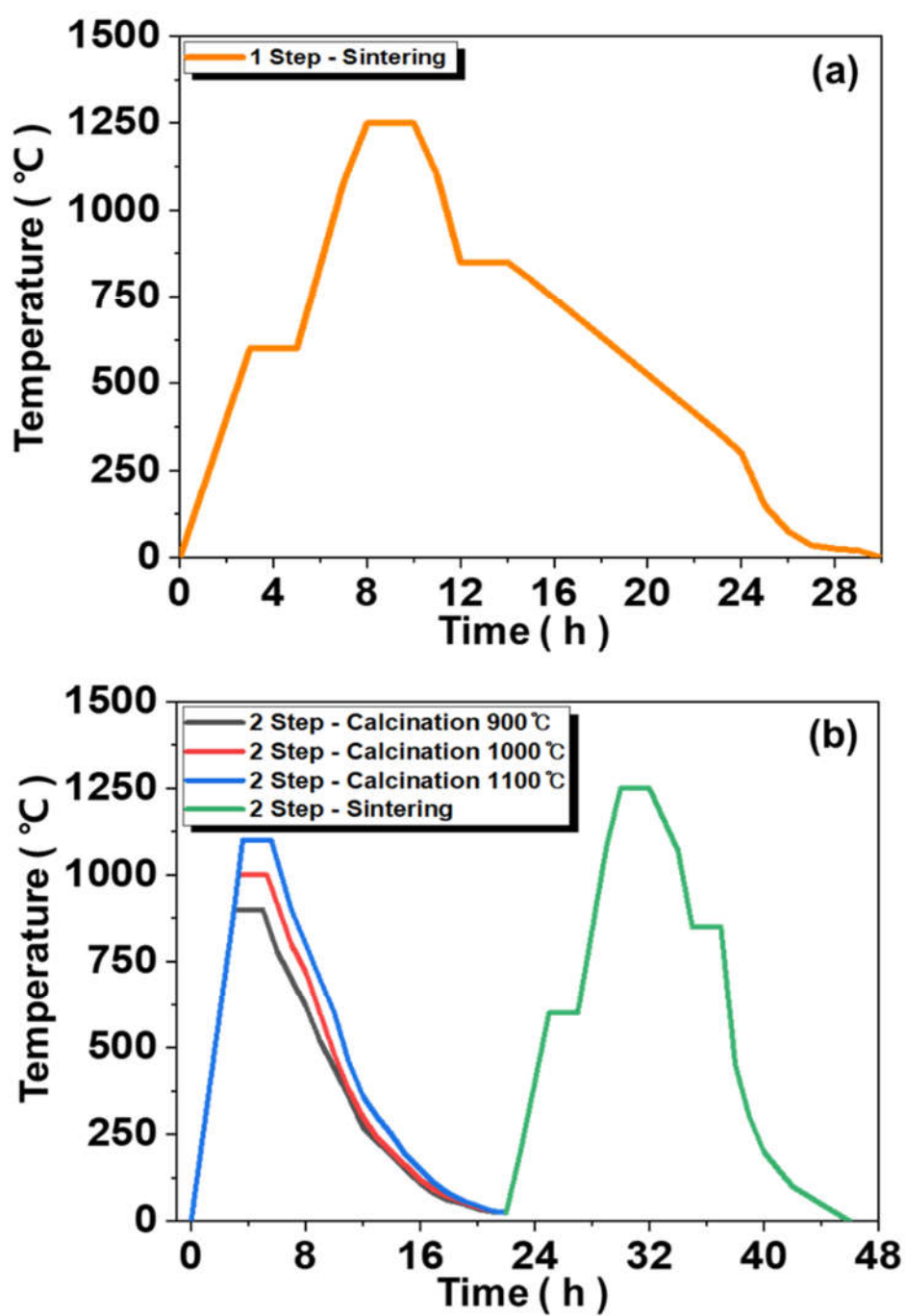


Figure S1. Heating profile of (a) 1-step SSR route and (b) 2-step SSR route.

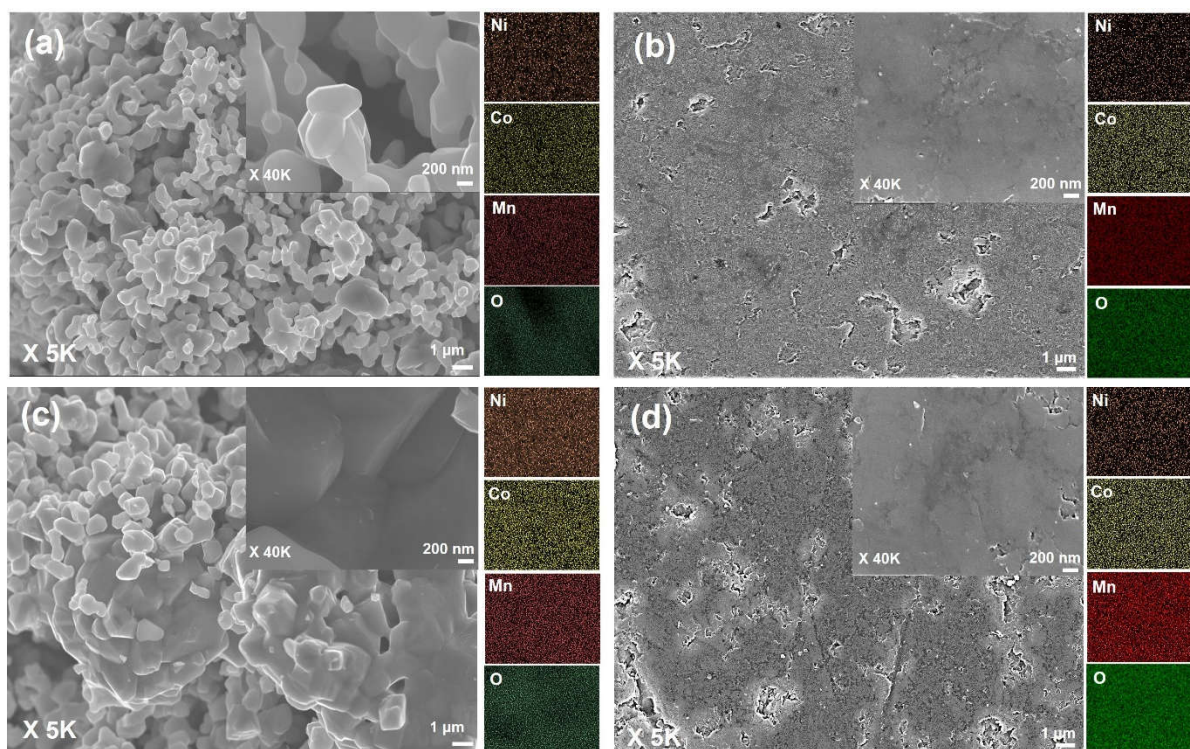


Figure S2. SEM images of the NMC via (a) a 2-step SSR route after calcination (900 °C) and (b) a 2-step SSR route after sintering (900 °C), and via (c) a 2-step SSR route after calcination (1000 °C) and (d) 2-step SSR route after sintering (1000 °C).

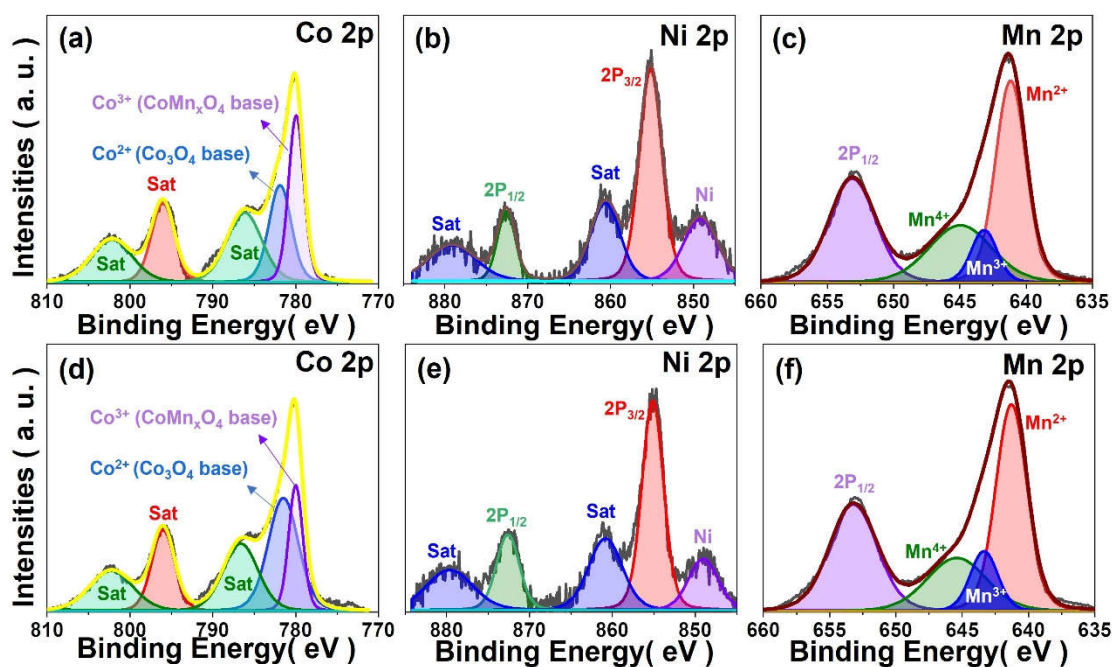


Figure S3. XPS spectra of (a)Co 2p (b)Ni 2p (c)Mn 2p of the NMC via 2-step SSR route (calcination temperature: 900 °C), and (d)Co 2p (e)Ni 2p (c)Mn 2p of the NMC via 2-step SSR route (calcination condition: 1000 °C).

Table S1. The results of XPS elemental analysis for (a) Co 2p, (b) Ni 2p, and (c) Mn 2p from NMC via 2-step SSR route (calcination temperature: 1100 °C), and (d) Co 2p, (e) Ni 2p and (f) Mn 2p from NMC via 1-step SSR route.

2-Step SSR (1100 °C)	(a) Co 2P		(b) Ni 2p	(c) Mn 2p		
	Co²⁺	Co³⁺	Ni²⁺	Mn⁴⁺	Mn³⁺	Mn²⁺
Area(%)	49.89	50.11	100	25.95	26.02	48.03
1-Step SSR	(d) Co 2p		(e) Ni 2p	(f) Mn 2p		
	Co²⁺	Co³⁺	Ni²⁺	Mn⁴⁺	Mn³⁺	Mn²⁺
Area(%)	51.75	48.25	100	35.22	35.40	29.38

Table S2. The results of XPS elemental analysis for O 2p from NMC via (a) 2-step SSR route (calcination temperature: 1100 °C) and (b) 1-step SSR route.

	(a) 2-step SSR (1100 °C) O 1S			(b) 1-step SSR O 1S		
	O_C	O_V	O_L	O_C	O_V	O_L
Area(%)	12	50	37	8	55	37

Table S3. B value and resistivity (ρ) at room temperature (25 °C) of the NMC via a 2-step SSR route and 1-step SSR route.

	B value	Resistivity (ρ 25 °C)
2-step Sintering 900 °C	3671	397.83
2-step Sintering 1000 °C	3727	589.41
2-step Sintering 1100 °C	3551	442.35
1-step Sintering	3549	12.05