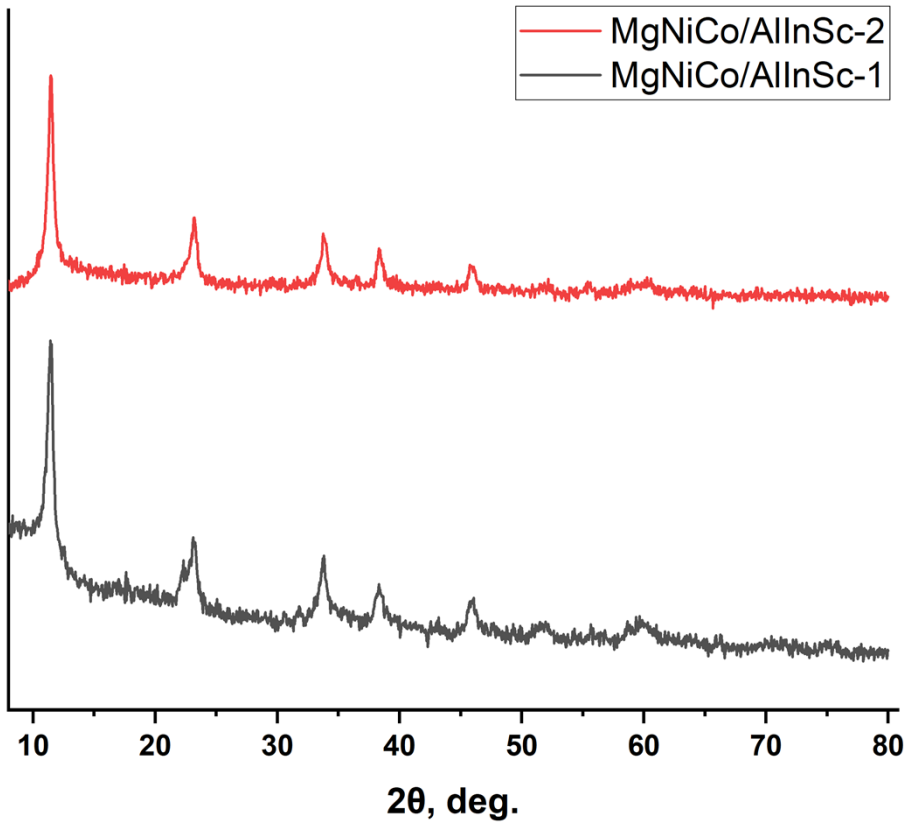

Fig. S0 X-ray diffraction of MgNiCo/AlInSc LDH sample before (black line) and after (red line) additional crystallization in 0.1 M Na_2CO_3 solution

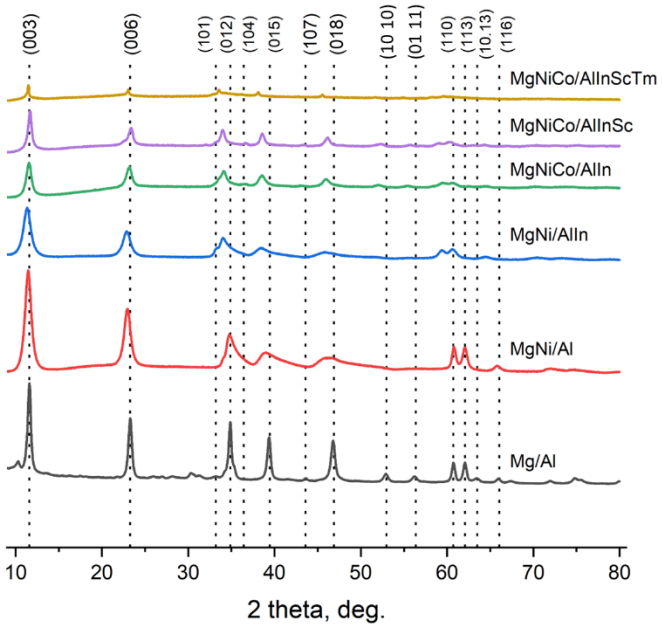

Fig. S1 Non-normalized X-ray diffraction of the LDHs from Mg/Al to MgNiCo/AlInScTm

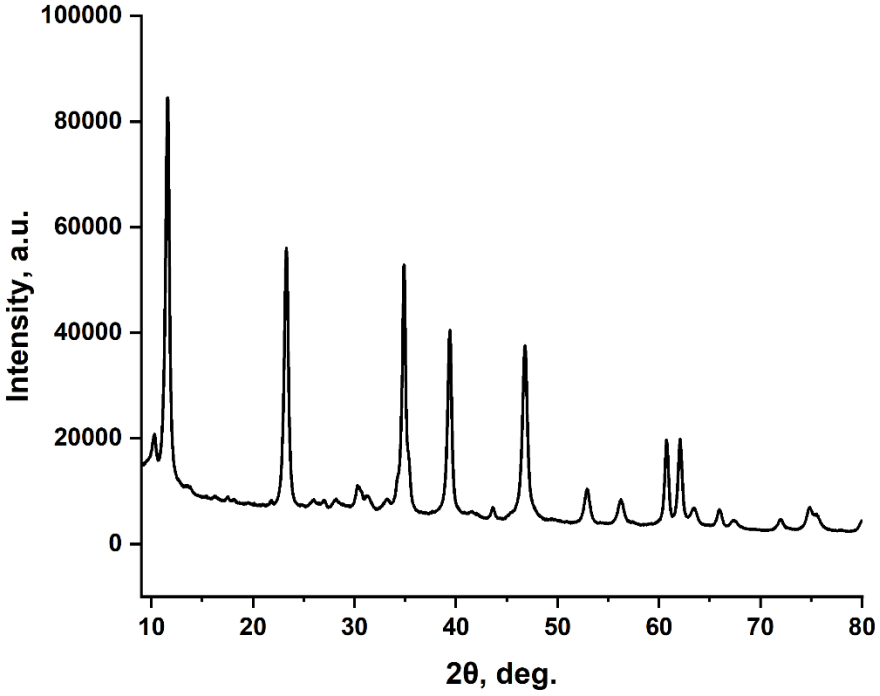

Fig. S2 X-ray diffraction of Mg/Al LDH sample

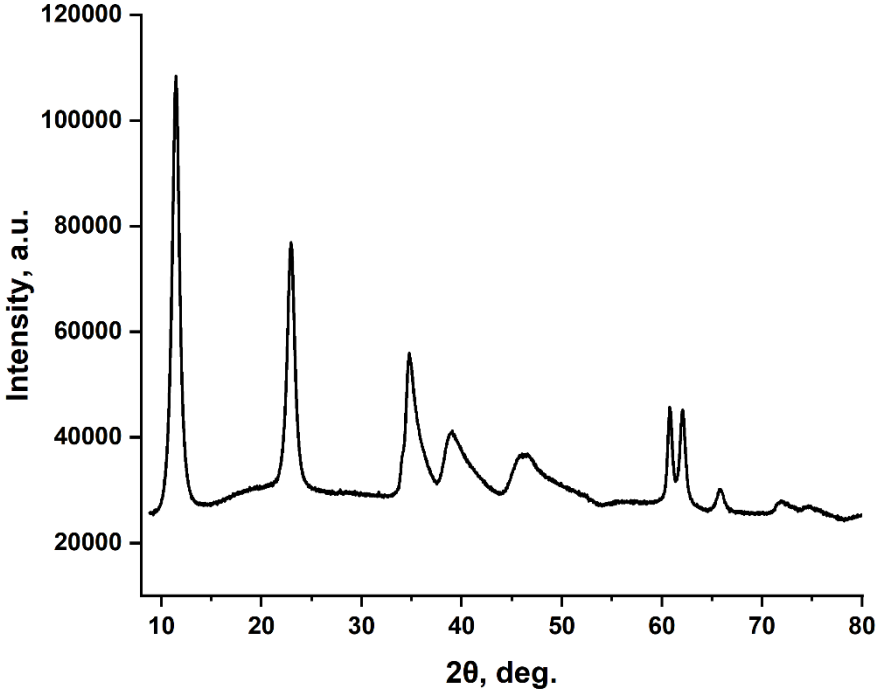

Fig. S3 X-ray diffraction of MgNi/Al LDH sample

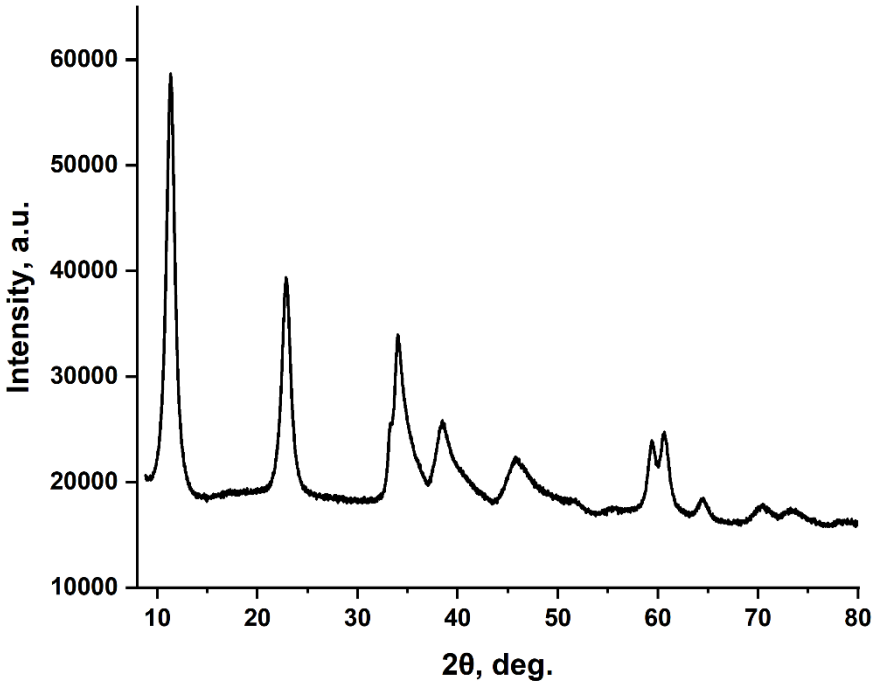

Fig. S4 X-ray diffraction of MgNi/AlIn LDH sample

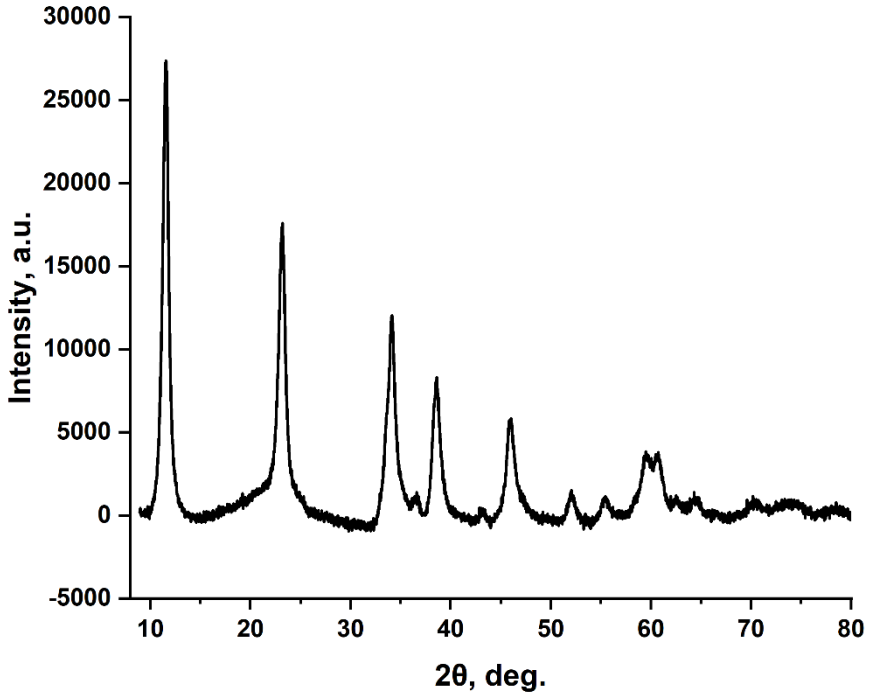

Fig. S5 X-ray diffraction of MgNiCo/AlIn LDH sample

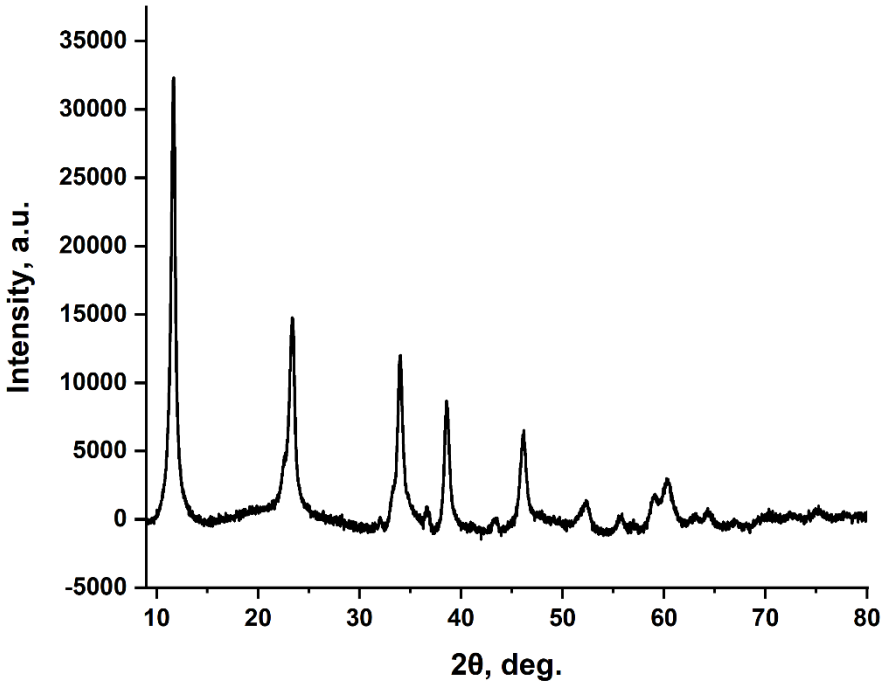

Fig. S6 X-ray diffraction of MgNiCo/AlInSc LDH sample

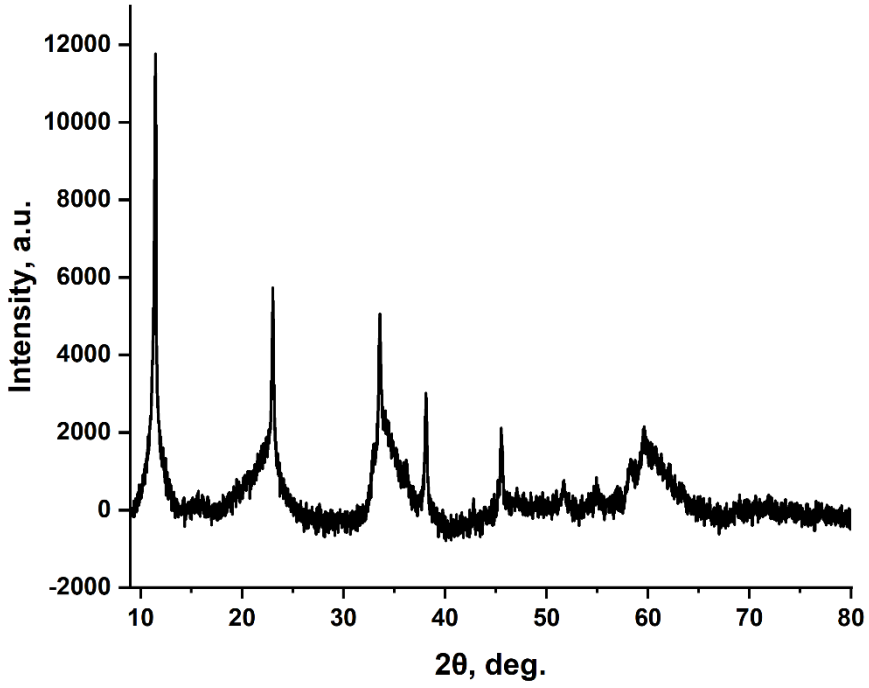

Fig. S7 X-ray diffraction of MgNiCo/AlInScTm LDH sample

Full synthesis procedure

MgNiCo/AlInSc LDH as an example.

Me^{2+}/Me^{3+} cation ratio = 3/1

Sum of divalent cations (Mg+Ni+Co) = 5 mmol, they were taken in an equimolar amount, so each one is 1.67 mmol.

Sum of trivalent cations (Al+In+Sc) = 1.67 mmol, they were also taken in an equimolar amount so each one is 0.56 mmol.

Initial reagents were mixed in an agate mortar and manually ground for 5 minutes at room temperature. After a homogeneous powder was obtained, solid Na_2CO_3 (25 mmol) and NaOH (5 mmol) were added to it, and the mixture was subsequently ground for 30 minutes to obtain a viscous homogeneous paste. The paste was washed with distilled water (100 ml) into the hydrothermal synthesis vessel. The vessel was sealed and left for one day at 98 °C. We found experimentally that adding an additional saturated alkaline solution in the middle of the hydrothermal treatment of mechanochemically synthesized samples promoted the crystallization degree, so after 24 hours at 98 °C, the vessel was cooled for another day, and then a 0.1 M Na_2CO_3 solution (100 ml) was added to the reaction mixture and left for two days at 98 °C. Then the vessel was cooled for a day, and the resulting precipitate was separated by centrifugation, washed with equivalent amount of distilled water three times, and then dried at 50 °C for two days.

Configurational entropy calculation example

Element	Weight %
C K	9.66
O K	48.08
Mg K	2.17
Al K	2.10
Sc K	3.25
Co K	12.85
Ni K	13.56
In L	8.33

Fig. S8 EDAX results for 1 point on a MgNiCo/AlInSc LDH

№ of point	Mg	Al	Sc	Co	Ni	In
1	2.75	2.83	3.91	14.65	15.98	9.26
2	2.53	2.28	4.00	18.11	19.98	9.92
3	2.57	2.29	4.31	19.61	21.54	11.03
4	2. 59	2.23	3.94	18.81	20.73	9.71
5	2.60	2.31	3.87	17.22	18.83	9.78
6	3.87	2.96	2.75	10.98	12.20	1.32
7	2.71	2.41	3.62	19.39	21.77	9.21
8	2.00	1.85	3.11	13.39	14.39	8.11
9	1.29	1.19	2.63	12.10	13.18	6.92
10	2.55	2.29	3.86	16.94	18.27	9.93
11	2.80	2.52	3.70	15.73	17.07	9.49
12	2.17	2.10	3.25	12.85	13.56	8.33
Mean	**2.54**	**2.27**	**3.58**	**15.82**	**17.29**	**8.58**
Atomic weight	**24.305**	**26.98**	**44.96**	**58.93**	**58.69**	**114.82**
Amount of substance	**0.10**	**0.08**	**0.08**	**0.27**	**0.29**	**0.07**
Mole fraction	**0.12**	**0.09**	**0.09**	**0.30**	**0.33**	**0.08**

Experimental Me^{2+}/Me^{3+} cation ratio = (0.12+0.33+0.30)/(0.09+0.08+0.09) = **2.9**

$$S_{conf} = -R\sum_{i=1}^{N} x_i ln x_i$$

Where x is a mole fraction of each Me, so

-R*((0.12*ln(0.12))+(0.09*(ln(0.09))+
(0.09*(ln(0.09))+(0.30*(ln(0.30))+(0.33*ln(0.33))+0.08*(ln(0.08)))=
1.62R

Crystallinity index

https://youtu.be/D65k1yHPKaM?si=42R4udu4WEpKxjfK – we calculated the crystallinity indexes of our samples using this method of Dr. Shahid Ali from the Department of Physics, University of Peshawar.

Microstrain calculation

https://youtu.be/T95MDQStcGY?si=BvKC_Jw2QaV_31SV – we calculated the microstrains of our samples using the Halder-Wagner-Landford method described on this channel.