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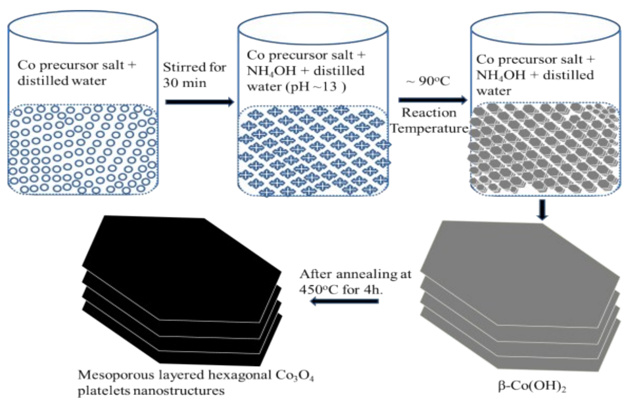
Mesoporous Layered Hexagonal Platelets of Co_3O_4 nanoparticle with (111) facets for battery: High Performance and Ultra-high Rate Capability

Prateek Bhojane[a], Lichchhavi Sinha[a], Rupesh S. Devan[a] and Parasharam M. Shirage[a,b*]

[a] Discipline of Metallurgy Engineering and Materials Science, Indian Institute of Technology Indore, Khandwa Road, Simrol, Indore – 453552, India. Tel. +91-732 4306739;

[b] Discipline of Physics, Indian Institute of Technology Indore, Khandwa Road, Simrol, Indore – 453552, India.

E-mail for corresponds: paras.shirage@gmail.com, pmshirage@iiti.ac.in



Scheme 1 Growth mechanism of mesoporous layered hexagonal platelets of Co_3O_4 structures.

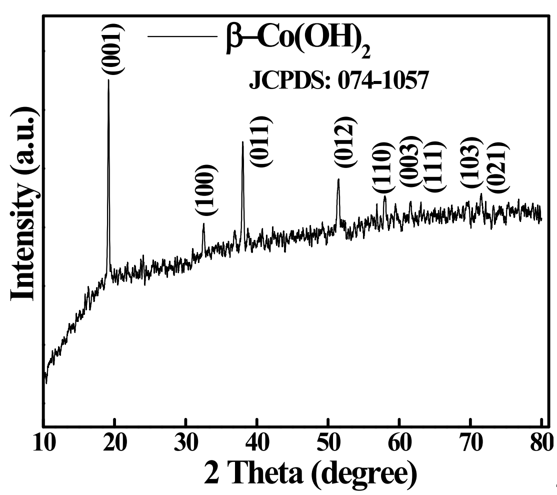


Fig. S1 shows the XRD pattern of as-prepared (β-$Co(OH)_2$) sample.

The XRD pattern shown in figure S1 matches well with the JCPDS file 074-1057 belongs to hexagonal crystal system, space group $P\overline{3}m1$ *(164)* confirms the formation of β-$Co(OH)_2$. The XRD pattern shows the presence of diffraction peaks at 2θ of 19.14^o, 32.49^o, 38.02^o, 51.46^o, 57.92^o and 59.54^o, etc. which are assigned to (001), (100), (011), (012), (110) and (003) diffraction peaks of hexagonal β-$Co(OH)_2$ phase and matches well with the above JCPDS file.

Table S1: Specific capacity as a function of current densities.

Current density (mAg^{-1})	**Capacity ($mAhg^{-1}$)**
434.78	137.58
869.57	135.59
1304.35	132.32
2608.7	124.00
3478.26	123.18
4347.83	119.66
5217.39	119.53
6956.52	117.10
8695.65	114.92
10434.78	111.62
12173.91	108.60
14782.61	106.79
16521.74	105.34
19130.43	103.82
20869.57	101.72
26086.96	98.06
30434.78	95.83
34782.61	91.71
39130.43	89.25
43478.26	84.59

Table S2. The comparison of specific capacity obtained from various synthesis methodologies and their morphology of Co_3O_4 electrodes.

Morphology	Synthesis method	Specific capacity ($mAhg^{-1}$)	Current density (mAg^{-1})	Electrolyte used	Capacity retention, Cycles@mAg^{-1}	Ref
Mesoporous microdisks like Co_3O_4	Solvo-thermal	1032	100	1 M $LiPF_6$ solution in (EC/DMC/DEC) (1:1:1)	74.12%, 30 Cycles@100	1
Mesoporous Co_3O_4	Two Solvent method	1489	50	1 M $LiPF_6$ solution in (EC/DMC) (1:1)	76%, 25 cycles@ 50	2
Co_3O_4/porous electrospun carbon nanofibers	Electro-spinning	952	100	1 M $LiPF_6$ solution in (EC/DMC) (1:1)	96.95%, 100 cycles@100	3
Self-assembled hairy ball like Co_3O_4 nanostructure	Hydrothermal	1768	100	1 M $LiPF_6$ solution in (EC/DMC) (1:1)	48%, 50 cycles@100	4
Mesoporous Co_3O_4 nanoflakes	Microwave assisted Hydrothermal	1192	89	1 M $LiPF_6$ solution in (EC/DMC) (1:1)	74%, 300 cycles@445	5
Co_3O_4 hollow-structured nanoparticles	Impregnation reduction	1107	50	1 M $LiPF_6$ solution in (EC/DMC) (1:1)	79%, 50 cycles@50	6
Co3O4 nanocages	Hydrothermal	1116	50	1 M $LiClO_4$ solution in (EC/DMC/DEC) (1:1:1)	77%, 50 cycles@178	7
Nanobowl array and Nanotubes of Co_3O_4	Thermal Decomposition	1293 and 1250	35	1 M $LiPF_6$ solution in (EC/DMC/DEC) (1:1:1)	57% and 69% after 10 cycles@35	8
Co_3O_4 nanoparticles with opened-book morphology	Solvothermal	1408	100	1 M $LiPF_6$ solution in (EC/DMC/DEC) (1:1:1)	67%, 25 cycles@100	9
Bare/Intrinsic Mesoporous Co_3O_4 layered hexagonal platelets	**Chemical bath**	**137**	**434.78**	**2 M KOH electrolyte**	**81.25%@ ~12170, 2020 cycles**	**This work**

Table S3. Energy density and power density comparison with previous reports.

Sample name	Energy density ($Wh kg^{-1}$)	Power density ($kW\ kg^{-1}$)	Ref.
Co_3O_4 hexagonal platelets (powder)	42.56	1.56	10
Co_3O_4 nanowire arrays (Ni-foam)	25.5	11	11
3D nanoporous Co_3O_4/Carbon (powder)	20.44	16	12
1D Co-Ni/ Co_3O_4-NiO core/shell	23	5.5	13
Mesoporous layered hexagonal platelets of Co_3O_4	**32.03**	**9.33**	**(This work)**

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