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Electronic Supporting Information for

Facile and cost-effective growth of highly efficient $MgCo_2O_4$ electrocatalyst for methanol oxidation

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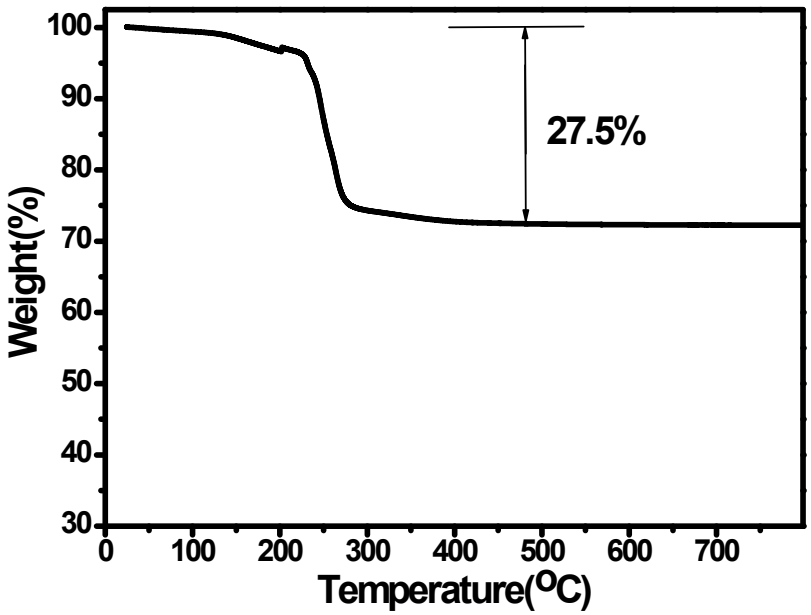

Fig. S1: TGA analysis of precursor carried out between 25 to 800 ^{o}C in air atmosphere.

The total weight loss of 27.5% was observed during the TGA analysis of sample. The weight loss was mainly observed in two steps. The first weight loss of ~4% upto 220 ^{o}C was mainly attributed to loss of residual water, burnout organic species involved in precursor powder and second weight loss of ~23.5% upto 380 ^{o}C was mainly attributed to the to the conversion of as prepared to pure $MgCo_2O_4$.

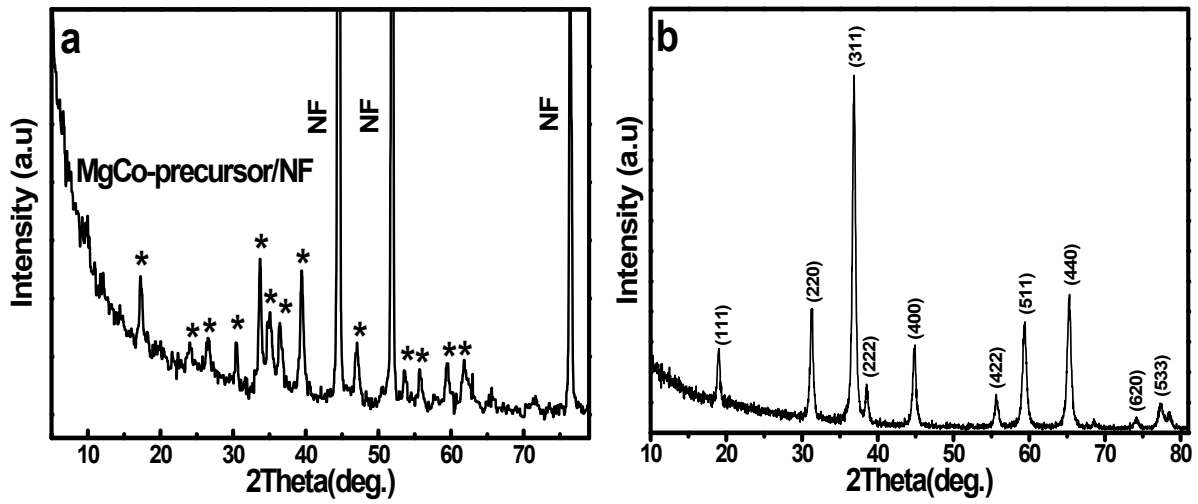

Fig. S2: XRD pattern of (a) MgCo-precursor (b) $MgCo_2O_4$ powder annealed at 400 ^oC for 2h in air atmosphere.

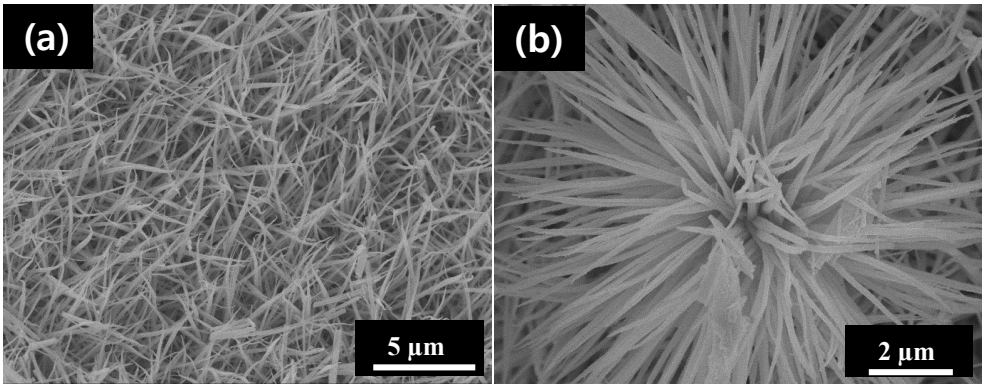

Fig.S3: FE-SEM images of Co_3O_4/NF at different magnifications.

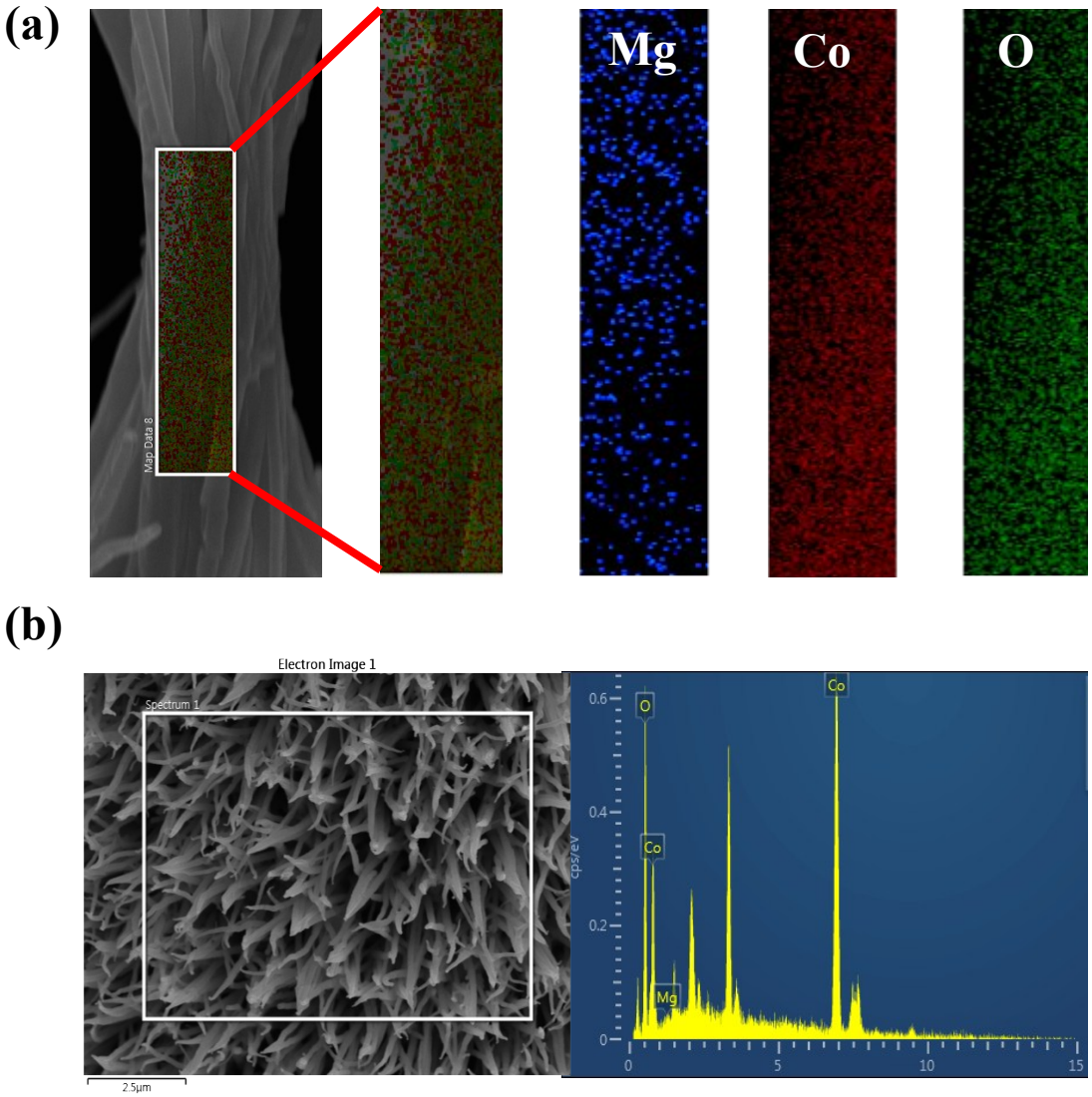

Fig. S4: (a) EDS elemental color mapping (b) EDS spectrum of $MgCo_2O_4$ nanorods.

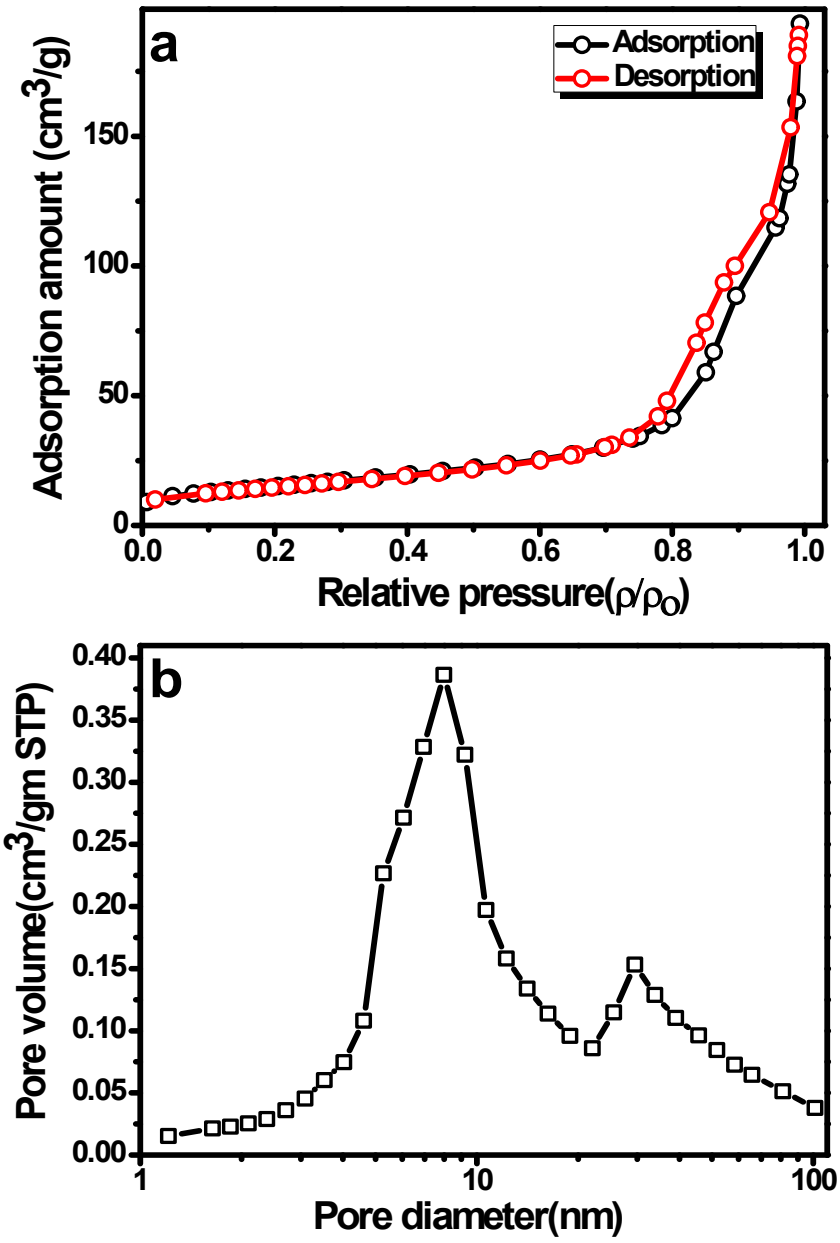

Fig. S5: (a) Nitrogen adsorption-desorption isotherm (b) BJH pore size distribution for the $MgCo_2O_4$.

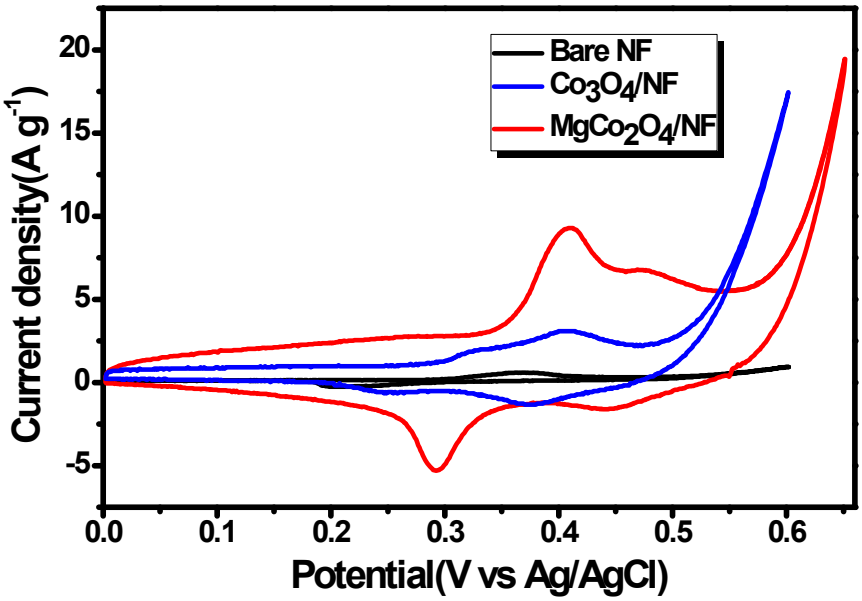

Fig. S6: CV curves of bare NF, Co_3O_4/NF and $MgCo_2O_4$/NF electrode in 1M KOH at scan rate of 10 mV S^{-1}.

Table S1: Comparison of different spinel oxide material used as an electro-catalyst for methanol oxidation.

No.	Catalyst	Method	Electrolyte (M)	Potential window (V)	Current density	Scan rate (mV s^{-1})	Stability	Ref
1	$NiCo_2O_4$ /MWCNT	Grinding followed by calcination	1M KOH +6.0M methanol	0-0.8	400 mA cm^{-2}	100	76% retention after 500 cycles	3
2	Co_3O_4 /NiO	Hydrothermal	1M KOH +0.5M methanol	0-0.75	140 mA cm^{-2}	25	100% retention after 500 cycles	11
3	$NiCo_2O_4$	Electrodeposition	1M KOH +0.5M methanol	0-0.6	50 A g^{-1}	10	91% retention after 1000 cycles	12
4	$CuCo_2O_4$	Hydrothermal	1M KOH +0.5M methanol	0-0.6	51 A g^{-1}	NA	NA	13
5	$MnCo_2O_4$	Co-precipitation	1M KOH +0.5M methanol	0-0.7	80 A g^{-1}	10	92% retention after 500 cycles	14
6	$NiCo_2O_4$ /rGO	Hydrothermal	0.1M KOH +0.5M methanol	0-0.8	0.035 mA cm^{-2}	50	79.3% retention after 500 cycles	22
7	$NiCo_2O_4$	Hydrothermal	1M KOH +0.5M methanol	0-0.7	51 A g^{-1}	10	92% retention after 500 cycles	23
8	$NiCo_2O_4$	Hydrothermal	1M KOH +0.5M methanol	0-0.6	134 mA cm^{-2}	10	88% retention after 500 cycles	25
9	$MgCo_2O_4$	Co-precipitation	1M KOH +0.5M methanol	0-0.65	98 A g^{-1}	10	94% retention after 500 cycles	This work

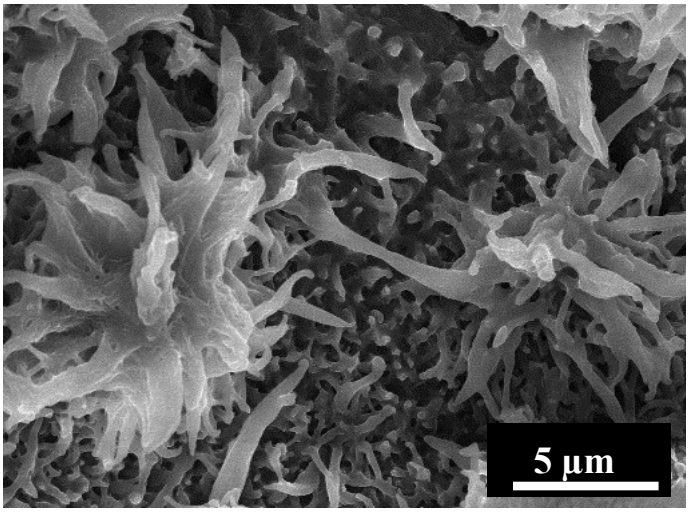

Fig. S7: FE-SEM image of $MgCo_2O_4$/NF electrode after cycling test.

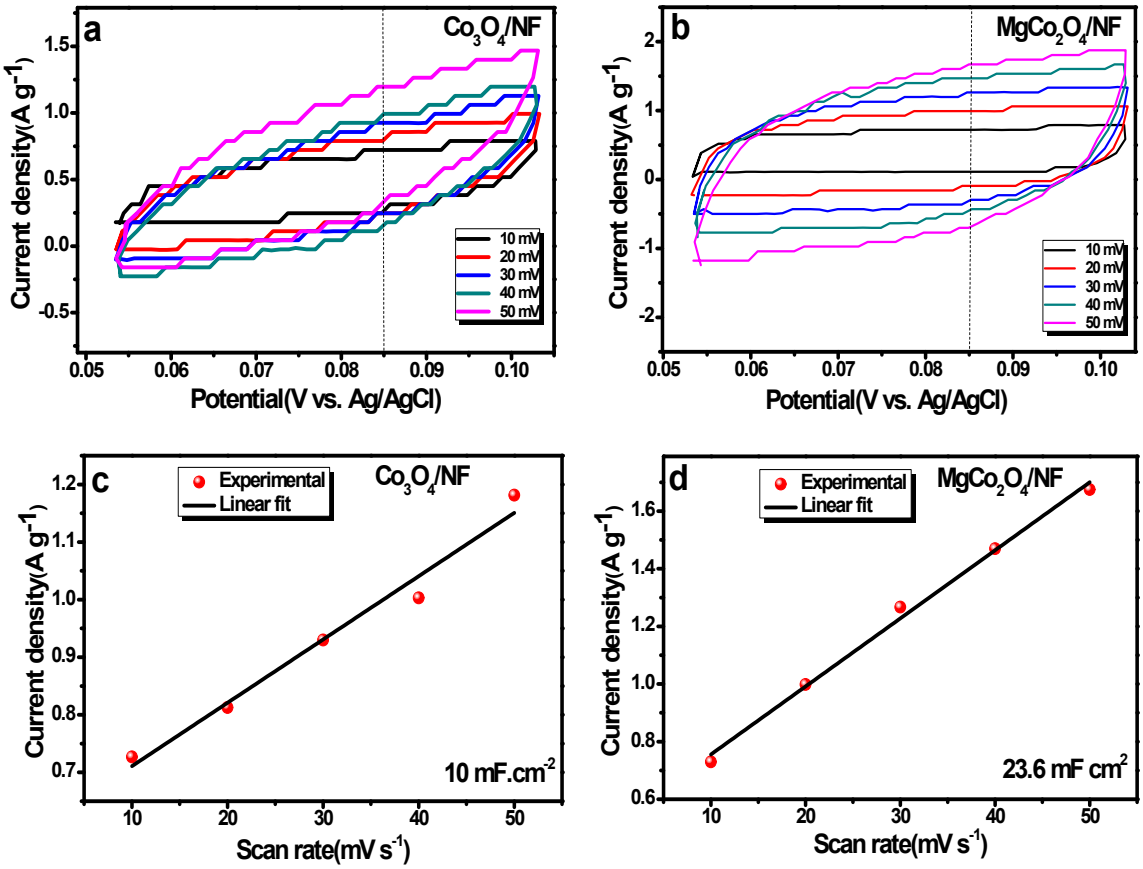

Fig. S8 (a, b) CV curves of Co_3O_4/NF and $MgCo_2O_4$/NF in non-faradic region (0.05-0.1 V vs. Ag/AgCl) at different scan rate ranging from 10-50 mV S^{-1} (c, d) The graphs of anodic current density (measured at 0.085 V vs. Ag/AgCl) versus scan rate.

Active site calculation:

The number of active sites (n) examined by CVs of electrodes carried out in phosphate buffer solution (pH=7) at the scan rate of 50 mV s^{-1}. The value of n (mole) can be calculated using equation 2, after determining the number of voltammetric charges (Q) after deduction of bare NF value.

$$n = \frac{Q}{2F} \tag{S1}$$

Where F is Faraday constant (96480 C mol^{-1}).

The value of Q for bare NF, Co_3O_4/NF and $MgCo_2O_4$/NF catalyst electrodes were 8.08 x 10^{-3} C, 2.861 x 10^{-1} C and 9.234 x 10^{-1} C(Obtained from Figure S8).

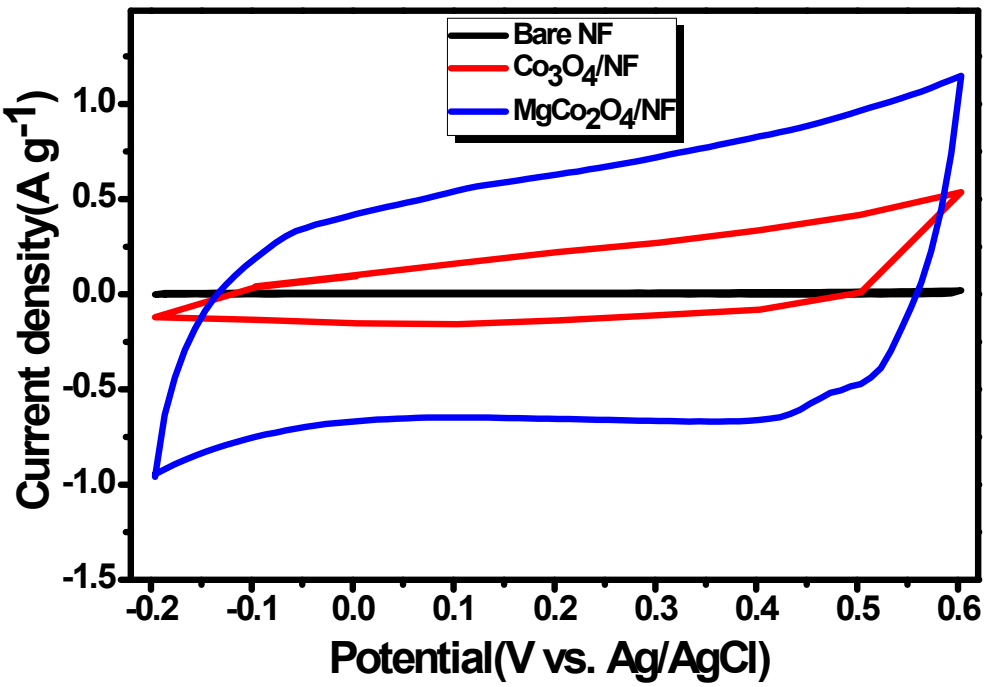

Fig. S9: CVs of bare NF, Co_3O_4/NF and $MgCo_2O_4$/NF catalyst electrodes in Phosphate buffer solution (pH=7) between -0.2 to 0.6 V at the scan rate of 50 mV s^{-1}.