Electronic Supplementary Material (ESI) for New Journal of Chemistry.

Supporting information

Synthesis of $Co_3V_2O_8/CN_x$ hybrid nanocomposite as an efficient electrode material for supercapacitors.

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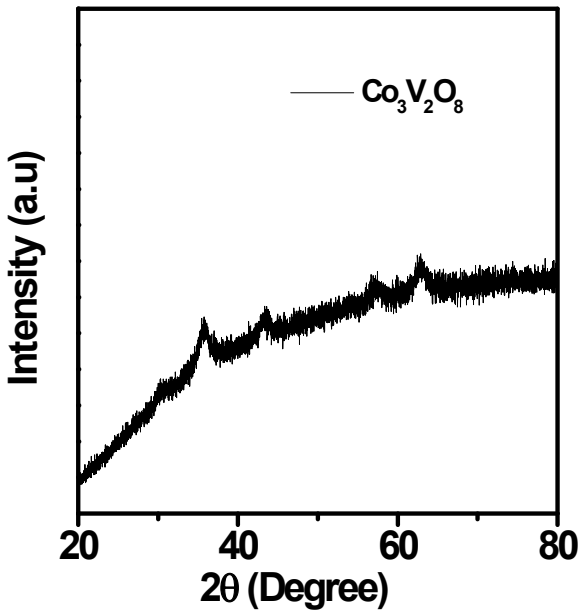

Figure S1. P-XRD pattern of only $Co_3V_2O_8$ nanocomposite

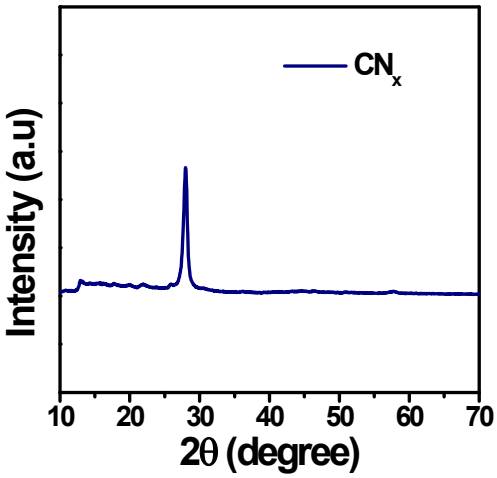

Figure S2. P-XRD pattern of CN_x

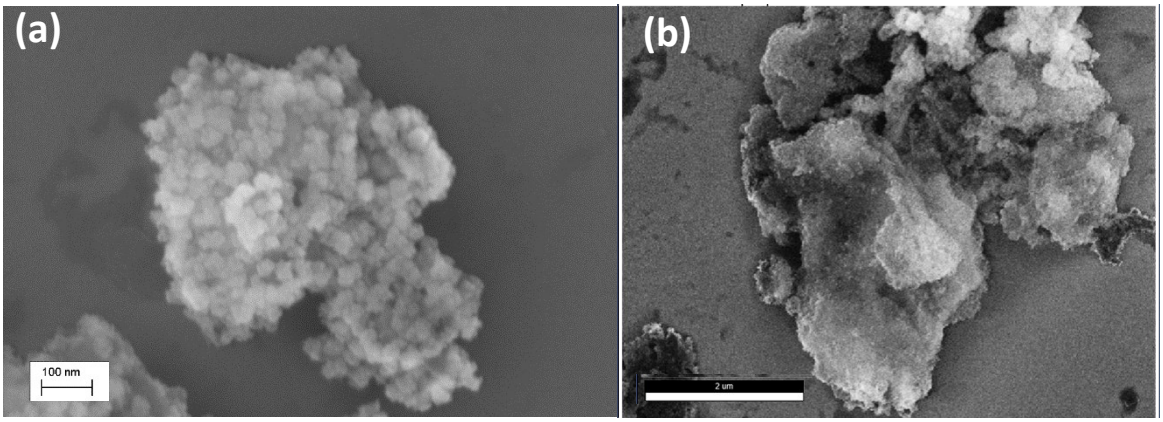

Figure S3. (a and b) SEM image of $Co_3V_2O_8/CN_x$ composite

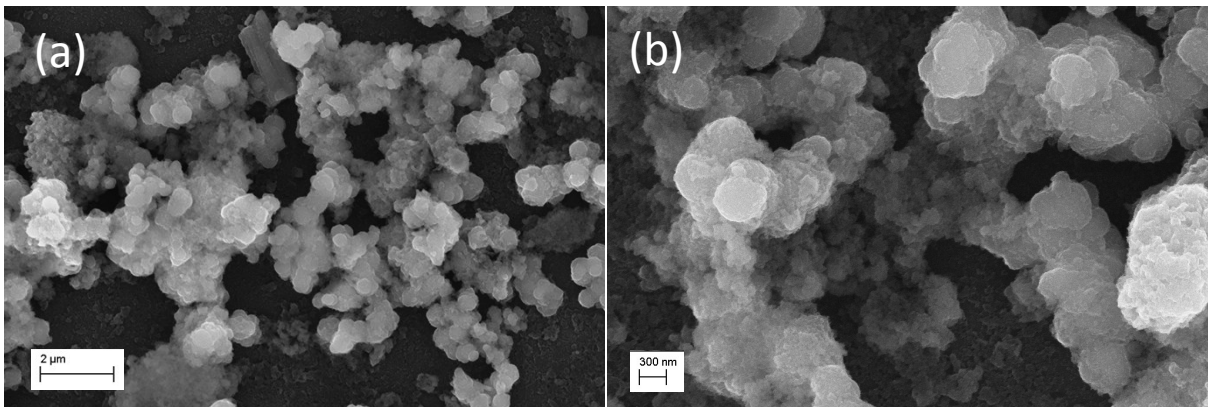

Figure S4. (a and b) SEM image of $Co_3V_2O_8$ only

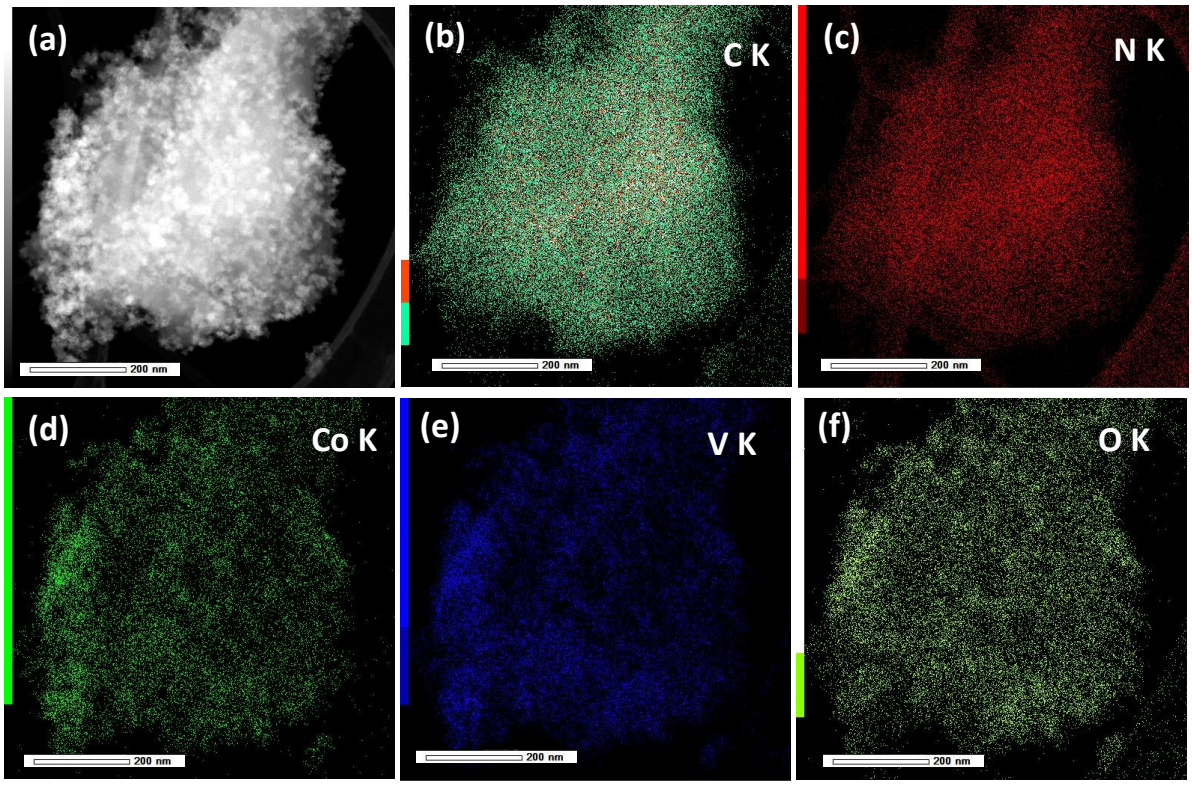

Figure S5. (a)STEM image and corresponding Elemental mapping (b-f) of $Co_3V_2O_8/CN_x$.

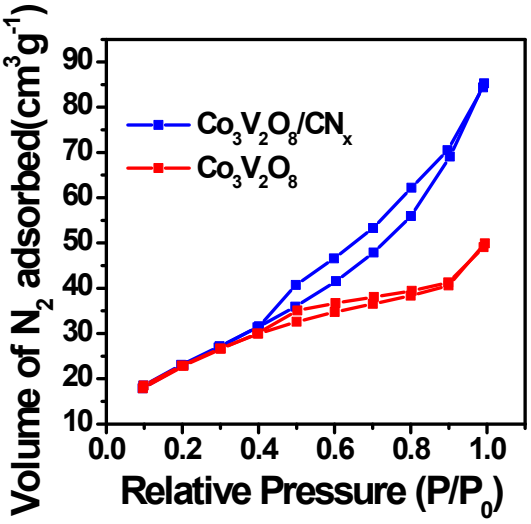

Figure S6. N_2 adsorption–desorption isotherm of $Co_3V_2O_8/CN_x$ and $Co_3V_2O_8$

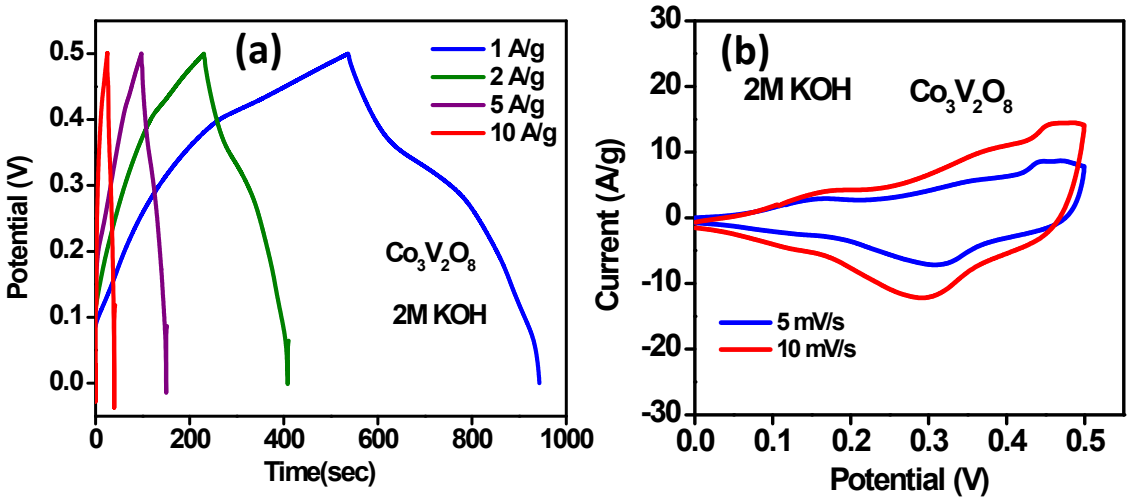

Figure S7. (a) GCD curves of $Co_3V_2O_8$ only composite at diff. current density (b) CV curves of $Co_3V_2O_8$ at diff. scan rate

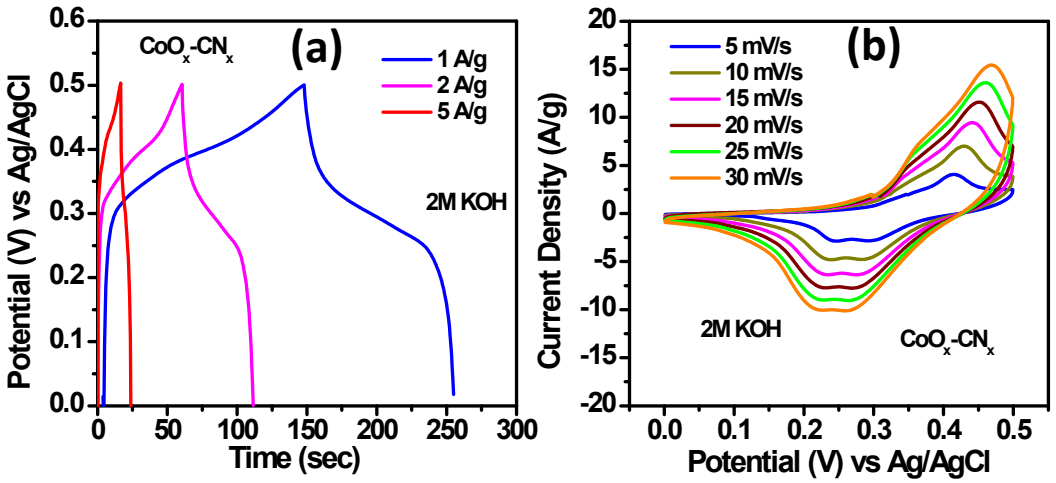

Figure S8. (a) GCD curves of CoO_x-CN_x composite at diff. current density (b) CV curves of CoO_x-CN_x at diff. scan rate

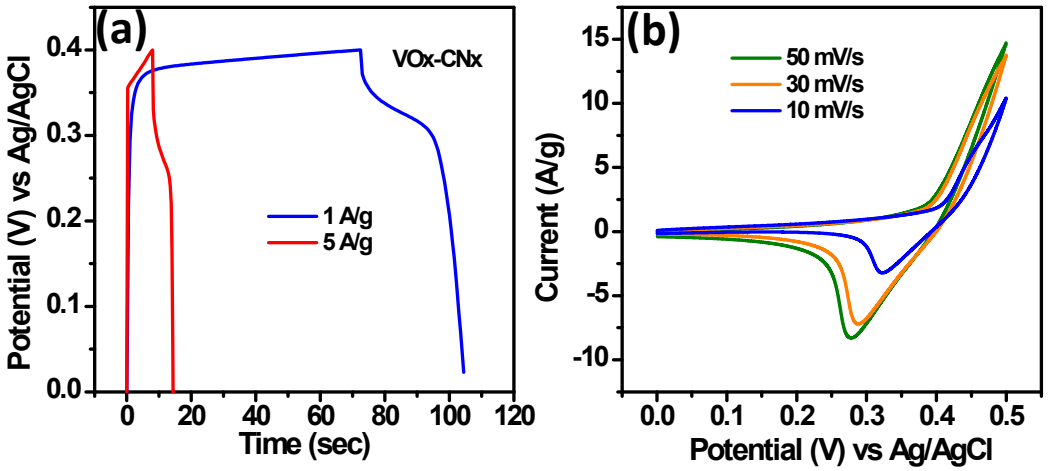

Figure S9. (a) GCD curves of VO_x-CN_x composite at diff. current density (b) CV curves of VO_x-CN_x at diff. scan rate

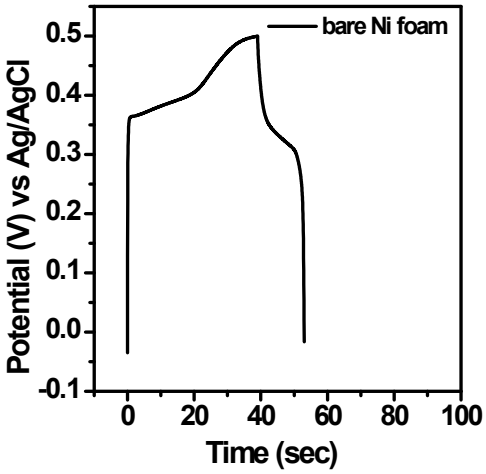

Figure S10. Galvanostatic charge discharge profile of bare Ni foam at current of 1mA

Characterizations:

For synthesis of carbon nitride, muffle furnace was used and bought from Scientific Engineering Corp.(Mumbai, India). The powder x-ray diffraction pattern (p-XRD) of samples was performed by Bruker DAVINCI D8 ADVANCE diffractometer equipped with Cu Kα radiation (λ= 0.15406 nm).TGA was done using TA instruments (discovery series, Waters LLC). Field-emission scanning electron microscope (FESEM) system (Carl Zeiss, Germany make, Model: ∑igma) was used for taking FESEM images and FESEM samples were prepared by casting a drop on a Si-wafer and dried at 45^0C. The surface morphology was investigated by Transmission Electron Microscopy (TEM, JEOL F200) operated at 200 kV. High-Resolution TEM (HRTEM) was also taken using same instrument. TEM samples were prepared by taking 10 µl solution from a stock of 0.25mg/ml and dried at 35^0C. XPS

measurements were done using VG Microtech where monochromatic Mg Kα X-ray was the source. XPS was taken from the sample deposited on silicon wafer. Electrochemical measurements were performed with an Electrochemical Workstation (Autolab, Metrohm, PGSTAT 320N. A conventional three-electrode system, Co3V2O8/CNx on Ni foam as a working electrode, platinum wire as a counter electrode and Ag/AgCl as a reference electrode were used. pH of the working solution was measured before experiment by Hanna (HI 2209) pH meter.

Electrochemical measurements

Performance test of single electrode was tested in using a three electrode system with 2M KOH as electrolyte. Pt wire was used as counter electrode and Ag/AgCl electrode was used as reference electrode whereas $Co_3V_2O_8/CN_x$ over NF was used as working electrode. The specific capacitance of single electrode was calculated from GCD curves using the following equation.

$$C_s = \frac{2I\int Vdt}{m(V_f - V_i)^2}$$

Where C_s = specific capacitance

I = current applied (mA)

dt = discharge time (sec)

m = mass of the active material (mg)

$V_f - V_i$ = potential window (V)

$\int Vdt$ = area under discharge curve

From the CV curve, specific capacitance of the electrode material was calculated using the following equation

$$C_s = \frac{\int IdV}{2m(V_f - V_i)\square}$$

Where $\int IdV$ = area under CV curve

m = mass of the electrode material

$V_f - V_i$ = potential window

$\square$ = scan rate

The charge balance of asymmetric supercapacitor was maintained by taking the weight ratio of positive and negative electrode using following equation.

$$\frac{M^+}{M^-} = \frac{C_s^- \Delta V^-}{C_s^+ \Delta V^+}$$

Where M^+ = mass of positive electrode material

M^- = mass of negative electrode material

C_s^+ = specific capacitance of negative electrode material

C_s^- = specific capacitance of negative electrode material

According to the calculation, weight of the positive and negative electrode are taken 2mg and 3.6mg respectively while the loading weight ratio was found to be 0.55.

Calculation of Energy density (E) and power density (P) was done using following equation.

$$E = \frac{I \int V dt}{m}$$

$$P = \frac{E}{t}$$