Syntheses of different transition metal oxides (TMOs) or hydroxides (TMHs) based nanomaterials or their composites for their applications in environmental remediation like water purification and sustainable energy storage (especially in supercapacitor) are the primary content of the thesis. TMOs and TMHs have been chosen due to their unique properties like wide range of band gap, variety of oxidation states, high abundance, ease of synthesis with different morphologies etc. These are the primary requirements to be looked into for a cost-effective photocatalyst, adsorbent and a pseudocapacitor. In the first two chapters, we have emphasized on the water purification by an efficient magnetic nanomaterial. In both the chapters, Fe_3O_4 has been used as the magnetic nanomaterial. Here, for the first time, we have exploited an unconventional redox pathway to synthesize Fe_3O_4 (nanocube and nanocomposite) from Fe(0) nanomaterial using our laboratory developed modified hydrothermal technique (MHT). We have presented the synthesis of a ternary hybrid, Pd@CdS@Fe_3O_4 in the first chapter. The synthesis involves three steps and for decoration of Fe_3O_4 by CdS and Pd we skipped the use of any surface modifier. Pd^{2+} has been reduced to Pd by the adhering S^{2-} on CdS. Here, Fe_3O_4 has been used to make the composite magnetic in nature. CdS acts as the visible light photocatalyst and Pd acts as the scavenger of electrons. This efficient ternary visible light phtocatalyst has been used for oxidative photo degradation of a water pollutant rhodamine B (RhB) dye. In the second chapter, we have again considered to synthesise a magnetic nanocomposite Fe_3O_4-MnO_2 via an uncommon synthetic strategy. During the process, Fe(0) and $KMnO_4$ have been mixed in aqueous medium as the oxidant and reductant respectively. The evolved hierarchical mesoporous Fe_3O_4-MnO_2 nanocomposite has then been used as the magnetic adsorbent for removal of cationic dyes methylene blue (MB) and crystal violet (CV) from waste water. As both Fe_3O_4 and MnO_2 exhibit excellent pseudocapacitance properties individually, we have tested the pseudocapacitive activity of the as-synthesized composite in neutral electrolyte. As a pseudocpacitor, it exhibits high specific capacitance value with very high specific energy value. In the last three chapters, we have exhibited the effect of mixed metal oxides (chapter 4), morphology of nanomaterials (chapter 5) and composition in a particular composite (chapter 6) to increase the superiority of a pseudocpacitor. In this respect, we have synthesized ultrathin 2D CO_3O_4 and $Co_3V_2O_8$ and it has been observed that the $Co_3V_2O_8$ exhibits better pseudocapacitive activity. Here, ammonia has been introduced that plays a crucial role during the preparation of ultrathin 2D structure. When it has been coupled with AC (activated carbon) to construct aqueous asymmetric super capacitor (AAS), the two electrode cell exhibits very high specific energy value. To study

the morphology effect, we have synthesized hierarchical nanostructure (HNS) and cubic nanostructure (CNS) of the same compound, $CoSn(OH)_6$. Here also, ammonia has been used to construct the HNS sample and NaOH has been used to transform it to CNS. Due to the morphology driven advantage, HNS sample exhibits superior electrochemical activity over CNS. In this case AC also has been used as the negative electrode to construct HNS $CoSn(OH)_6$//AC which exhibits excellent electrochemical activity. Finally, we have reported the synthesis both the positive electrode and negative electrode to construct AAS. $Ni_3V_2O_8$@MWCNT and β FeOOH@rGO have been used as the positive and negative electrode, respectively. In both the cases, a selected amount of nanomaterial loading on carbonaceous sample has been observed to show up extraordinary pseudocapacitance activity. The as-fabricated AAS exhibits very high specific energy value which is the main interest of our work.

Keywords: Transition metal oxide (TMO), Transition metal hydroxide (TMH), Multiwalled carbon nanotube (MWCNT), rGO, Activated carbon (AC), Photocatalyst, Adsorbent, Pseudocapacitor, Aqueous asymmetric supercapacitor (AAS).