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Conventionally, most of the energy requirements are met by utilizing fossil fuels. Since, energy demand is increasing, this has led to depletion of fossil fuels. Therefore, there is intense interest in research on generation as well as storage of energy, utilizing new means and sources. This attention is necessary for future technological development. As the sources of renewable energy are often free as well as eco-friendly, it is a very attractive option. However, the key issue of storage, besides effective utilization of renewable energy must be addressed. Hence, one must find effective energy storage methods and devices. The significance of proper storage cannot be overemphasized. The need has now been widely recognized. Batteries are the conventional choice for energy storage; used in many applications. However, expanding market requires alternative pulse batteries that can offer high power and long cycle life. Motivated by this demand and due to their high power density, long cycle life, and fast charging rate, supercapacitors have attracted growing interest. These characteristics demonstrate great potential of supercapacitors in complimenting or replacing batteries in many applications.

The present investigation is about supercapacitors, particularly the varieties known as electric double layer capacitors (EDLCs) and pseudocapacitors. One of the key themes investigated is the synthesis of suitable electrode materials. The focus is on carbon forms (activated carbon and graphene), transition metal oxide ($MnO_2$), and composite materials (PEDOT/rGO and

$Nb_2O_5$/rGO). Consequent to synthesis, morphology and structural parameters have been studied using the standard techniques of SEM, XRD, BET, TGA and Raman spectroscopy. Further, the electrochemical properties of the synthesized material have been studied as an electrode, in two-electrode symmetric supercapacitor system, using suitable aqueous, organic and ionic liquid based electrolytes. The porous activated carbon was obtained from different biomass precursors. Characterization techniques employed were a.c. impedance spectroscopy, cyclic voltammetry and charge discharge test. It was deduced from these studies that apart from suitable electrode materials, electrolyte choice also plays an important role in determining the overall performance of supercapacitors. Results show the great potential of synthesized materials for use as electrode in supercapacitors; when employed with suitable electrolytes. Synthesis, characterization and performance evaluation are three important components of this study; which seeks to identify factors contributing to better functioning of supercapacitors.