

# **Development of a Sustainable, Cost-Effective Supercapacitor for Energy Storage (SuperCap)**

*Popular Scientific Abstract of a PhD Thesis by Steffen Thrane Vindt*

If we want to maintain our current lifestyle in the future and still have a rich and thriving environment then we need to transit from fossil fuels to a clean renewable energy source. This is already in progress with especially windmills and solar cells handling a rapidly increasing amount of our electricity production. Unfortunately these are intermittent electricity sources and generally unsuited for mobile applications which as a result creates an increasing demand for energy storage. Many energy storage technologies exist today and no single technology has made the other obsolete. In this project several approaches have been developed to make supercapacitors a more cost-effective energy storage technology. A supercapacitor is a special type of capacitor that can store significantly more charge compared to a traditional capacitor. It has several advantages over batteries where some of the most important are its ability to charge much faster, deliver much higher powers and its much longer life time. Supercapacitors however have lower energy density (storage capacity) compared to high performance batteries like lithium batteries. To achieve widespread success it is therefore imperative that their energy density is improved.

In order to achieve this several advanced carbon nanostructures with extremely high capacitances were developed as electrode materials and among them some using only cheap abundant carbon sources which allows for the production of cheap high performance supercapacitor electrode materials. Furthermore several important discoveries and improvements were done on aqueous supercapacitor electrolytes and a new hybrid electrolyte system was invented forming the basis of a patent application.

These new developments facilitate the creation of more cost-effective high energy supercapacitors for energy storage. Such supercapacitors can be used to store green electricity from renewable sources and they can be used both in stationary and in mobile applications.