

# Magnetic Supercapacitor for Future Electric Vehicles

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Recently, electric vehicle technology has emerged, and autonomous car is just in front us. Accordingly, advanced energy storage device, which fulfills both high-energy density (Wh/kg) and high-power density (W/kg), has been searched. In response to this, we have proposed magnetic supercapacitor in US (2015) and WO (2013) patents. A magnetic supercapacitor has a dielectric layer positioned between magnetic layers. The magnetic layers comprise hard, soft magnetic material or magnetic exchange coupled magnet. Conceptually, a magnetic flux generated by the magnetic layers increases the permittivity of the dielectric layer, thereby enhancing the capacitance of the supercapacitor. When the magnetic layers comprise soft magnetic material, the capacitance of the supercapacitor can be controlled by changing current through a conductive segment. In this paper, experimental permittivity ( $\epsilon$ ), *i.e.*, ( $\epsilon = f(H_{app})$ ), and theoretical calculation of the electric polarization ( $P$ ) for a given magnetic moment, *i.e.*,  $P = f(m)$ , will be presented.