All-carbon Solid State Supercapacitors Based on Graphene

Nunzio Motta[1] , Jinzhnag Liu[1,2]

[1] School of Chemistry, Physics, and Mechanical Engineering, Queensland University of Technology, Brisbane, QLD, Australia

[2] School of Materials Science and Engineering, International Research Institute for Multidisciplinary Science, Beihang University, Beijing, 100191, China.

email: n.motta@qut.edu.au

Abstract

Graphene-based supercapacitors attracted a lot of interest due to the advantages of graphene over activated carbon and carbon nanotubes (CNTs) in energy storage. This energy storage technology is poised for an explosive growth, due to the high power density and to the flexibility of the material, which can be adapted to a number of applications, from mobile phones to electric cars. Conventional supercapacitors contain metal foils as current collectors, which suffer from corrosion by the acid or alkali electrolyte. We produced all-carbon solid-state supercapacitors using graphene electrodes and double-wall CNT films as current collectors. Though CNTs are relatively inferior compared to graphene in achieving high capacitance, their high electrical conductivity and 1D structure can be useful to rep[lace the metal when combined with graphene for making supercapacitors. The graphene was produced by a simple ultrasound assisted electrochemical exfoliation method. A very low resistance (5 Ω/sq) DWCNT film was coated onto plastic substrates. A thin layer of gelled electrolyte is sandwiched by two electrode films, therefore the whole device is flexible. High capacitance, around 10 mF/cm^2, is achieved with an electrode film less than 10 μm in thickness. The energy density of our devices is in the order of 10^{-3} Wh/cm^3, comparable to that of thin film Li battery. The power density is around 10 W/cm^3 [1] which is about 10 times higher than other works such as those based on laser-scribed graphene [2] .

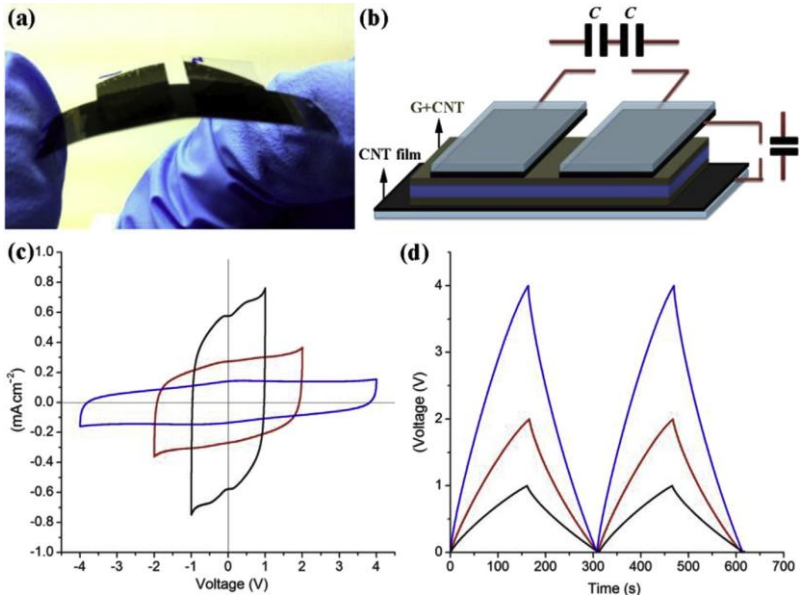

Fig 1 (a), (b) in-plane assembly of two supercapacitors. (c) CV curves measured at 60 mVs^{-1} for a single, two and four devices in series. (d) CD curves measured at 50 mAcm^{-2} for a single device, two, and four devices in series.

References

[1] J. Liu, F. Mirri, M. Notarianni, M. Pasquali, and N. Motta, *Journal of Power Sources,* vol. 274, pp. 823-830, 2015.

[2] M. F. El-Kady and R. B. Kaner, *Nature communications,* vol. 4, p. 1475, 2013.