Mangan Coated N-Graphene for Good Performance Electrode in Primary Battery Anode

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Abstract: Even though lithium is expected to remain the dominant battery technology for the next decade, new battery technologies are on their way. N-Graphene and Mn/N-Graphene have the potential to be used as an alternative electrode on primary battery anode. The results showed that the N-Graphene diffraction showed a weak and wide peak at $2\theta = 26.5°$ which indicates that N-Graphene was formed. The data is consistent with EDX data, where the abundance of N atoms in N-Graphene (4.68%). At the Mn / N-Graphene electrode a sharp peak appears at $2\theta = 31°$, indicating that Mn is deposited in N-Graphene. The EDX data also shows that Mn atoms are deposited in graphene (0.15%). Mn / N-Graphene has the highest conductivity value (1250 µS/ cm) compared to primary battery anodes (10 µS / cm), Graphite/N-Graphene (350 µS / cm) and N-Graphene (1157.33 µS / cm).

1   INTRODUCTION

Graphene, the type of carbon in the form of monolayer graphite, has a specific surface area of 2,600 m^2/g (Stoller et al., 2008) with a honeycomb-shaped structure that has the potential to produce higher lithium ion storage capacity (Eriksson, 2001), high electron mobility of 15,000 cm^2/Vs (Geng et al, 2011), extraordinary thermal conductivity of 3000 W/mK (Netro et al, 2009) and has good chemical stability and mechanical properties (Bolotin et al., 2008). The advantages of graphene is an interesting thing to form a composite material that is used as an electrode material on lithium ion batteries. However, pure graphene has poor pore affinity, low coulomb efficiency, high charge-discharge platform and low cycle stability so that it cannot be a direct substitute for carbon-based commercial electrode material in lithium ion batteries (Atabaki and Kovacevic, 2013). To overcome the poor pore affinity of graphene a doping is needed to fix it (Yang et al, 2015). A doping agent suitable for improving the pore affinity of graphene is nitrogen (Yu et al, 2013; Sun et al, 2012).

Nitrogen will modify the graphene structure so that it will strengthen the stability of graphene in each bond and improve porosity (Xing et al, 2016). Depositing Pt metal to graphene will improve the electrical properties and catalytic activity of Graphene (Rikson, 2014). Therefore, research is needed to improve the quality of primary batteries by combining Mn metal with N-graphene. The Mn metal used has an electrical conductivity of 6.2. 105 (S / m).

2   MATERIALS AND METHODS

2.1   Synthesis Graphite/N-Graphene

About 1 g of graphite was added to the glass beaker is then added 200 mL Ethanol Absolute, stirred for 1 hour. Then, 1 g of N/graphene was added with 200 mL of absolute Ethanol, stirred for 1 hour. The graphite-ethanol mixture was added into N/graphene-ethanol, and then stirred for 2 hours. Filtered using Whatmann no.42, then the precipitate was dried with an oven at 80°C and characterized by XRD.

2.2 Synthesis Mn/N-Graphene

About 1 g of MnCl$_2$ was added to the glass beaker is then added 200 mL Ethanol Absolute, stirred for 1 hour. Then, 1 g of N/graphene was added with 200 mL of absolute Ethanol, and then stirred for 1 hour. The MnCl$_2$-ethanol mixture was added into N/graphene-ethanol then stirred for 2 hours. Filtered using Whatmann no.42, then the precipitate was dried with an oven at 80^{0}C and characterized by XRD.

3 RESULTS AND DISCUSSIONS

3.1 Diffractogram of Zinc Anode, Graphite, Graphene and N-Graphene

X-ray diffraction data from primary battery anodes, graphite, graphene and N-graphene are shown in Figure 1.
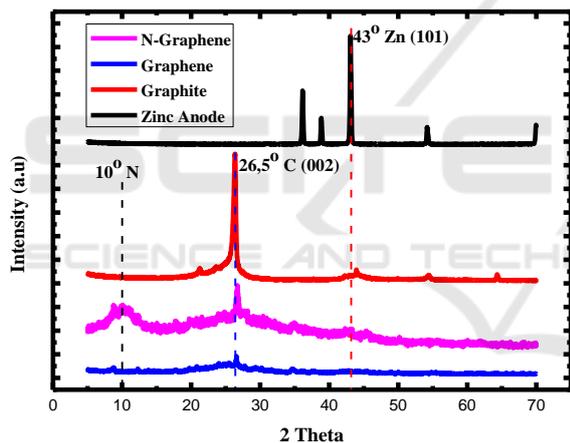

Figure 1: Diffractogram of Zinc anode, graphite, graphene and N-graphene.

The data above shows the XRD diffraction pattern of commercial primary battery anodes where there are sharp peaks and densities which are at $2\theta = 43^o$ Zn (101), graphite and graphene show peaks at $2\theta = 26.5^o$ which correspond to diffraction lines C (002) , where the sharp and tight peaks on the graphite diffraction pattern indicate that the particle size of graphite is large and overlapping and graphene has a weak and wide peak which indicates the particle size of nano-sized graphite and stacked on the interlayer of graphene. The occurrence of peak changes from the diffractogram is due to the bonding of graphite and oxidation and the entry of oxygen into the interlayer space in graphite (Jeong et al, 2008).

X-ray diffraction pattern of N-graphene which shows the peak at $2\theta = 10^o$ there is a fairly sharp but wide peak indicating that N from ammonia (NH$_3$) has been deposited into graphene. The above diffraction pattern also shows a peak that is at $2\theta = 26.5^o$ which corresponds to the diffraction line C (002), which has a tightly sharp peak and is surrounded by widened peaks which indicate that the particle size is nano-sized and stacked graphene on the interlayer of graphene which has been successfully synthesized. This data explains that N-graphene has been produced which is a modification of a graphene by doping N from ammonia into graphene.

3.2 Diffractogram of Graphite/ N-Graphene and Mn/N-Graphene

X-ray diffraction data from primary graphite/N-graphene and Mn/N-graphene are shown in Figure 2.
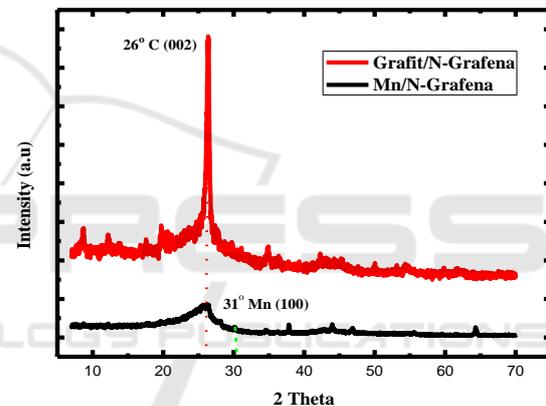

Figure 2: Diffractogram of Graphite/N-Graphene and Mn/N-Graphene.

The XRD diffraction pattern of graphite / N-graphene shows sharp and tight peaks at $2\theta = 26.5^o$C (002) which are specific to the intensity of carbon atoms which are still dominated by hexagonal graphite phases. Diffractogram changes indicate that N-graphene has been deposited into graphite. The XRD diffraction of Mn / N-Graphene shows a broad and weak peak at $2\theta = 26.5^o$ C (002) which is specific to the intensity of carbon atoms which is still dominated by the hexagonal phase and diffraction at $2\theta = 31^o$ Mn (100) which indicates that Mn is deposited into N-graphene (Jeong et al, 2008).

4 CONCLUSIONS

The electrode synthesis in the primary battery anode with graphite becomes graphene into N-graphene

using a modified Hummer method followed by depositing Manganese metal on the N-graphene compound. Where N-graphene is produced by deactivating graphene using ammonia (NH_3) so that graphene is reduced. The deformed graphene is modified and forms N-graphene which has a good catalyst activeness value and has a high conductivity value.

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