別紙様式５(Attached Form 5)

学位論文要旨 Abstract of Thesis

所属専攻 Field: Science 専攻(Field)
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Title of Thesis:
Study of Oxygenated Carbon Derivative for Energy Application
（エネルギーデバイスの応用を指向した酸化炭素材料に関する研究）

Abstract（within 1600 words）

The world energy consumption, along with CO_2 emission, has been increasing exponentially over the past 50 years or so. As we become more aware of "greenhouse gases" and their detrimental effects on our planet, it has become more important than ever to develop clean and renewable energy systems and advanced energy storage devices. Instead of burning fuel to create heat fuel cells, Li-ion battery and super capacitor convert chemical energy directly into electricity, making them one of the most efficient and environmentally benign technologies to meet the demand for alternative energy sources. In this view, in my present study, oxygenated carbon based materials have been demonstrated for some general applications in advanced energy conversion and storage including fuel cell, Li-ion battery and super capacitor.

Chapter 1 contains a short discussion regarding potential and importance of functionalized carbon based materials in advanced energy application materials. Beside a details upto date discussion regarding functionalized carbon based materials on fuel cell, Li-ion battery and super capacitor has been included.

Chapter 2 includes the details discussion on synthesis and characterization of carbon sphere (CS), a potential carbon material generated from glucose by hydrothermal method and oxidized carbon sphere (CSO). CSO shows considerable proton conductivity with high thermal stability. At room temperature, and 90% relative humidity, the proton conductivity of thin layer CSO on micro size comb electrode was found to be 8.7×10^{-3} S cm^{-1}, which is higher than similar graphene oxide (GO) sample (3.4×10^{-3} S cm^{-1}). In contrast to the conventional carbon based proton conductor, where the functional groups decompose

around 80 ^{0}C, CSO exists with stable morphology, and functional groups with reproducible proton conductivity up to 400 ^{0}C. The reasoning behind the proton conductivity and thermal stability has been discussed. We expect that CSO based proton conductor would be applicable for fuel cells, and sensing devices operating in high temperature.

Chapter 3 includes the discussion on the development of Li-ion anode based on Silicon oxycarbide (SiOC) phases generated in situ, within porous reduced graphene oxide (rGO). It is found that along with chemical and thermodynamic stability, SiOC/rGO anode exhibits high Li intercalation capacity, specific capacity and cycling stability of 507 $mAhg^{-1}$ with a columbic efficiency above 90% at 100 mAg^{-1} (50 cycles).

Chapter 4 includes the discussion of oxygen functionalized porous carbon (OPC) as efficient mixed electron / proton conductor with excellent capacitance property. The improved electrochemical performance of OPC mostly associated with transformation of high temperature treated inert carbon into an electrochemically active substance and ionic movement associated with oxygen functionalized groups in carbon surface during oxidation.

Carbon based materials have a unique set of properties including mechanical, electrical, catalytic, optical, and thermal properties which make them ideal candidates for a wide range of technical applications of electrochemical energy storage and conversion devices. Taking into account all the mentioned characteristics, carbon as a material for the storage of energy in batteries and fuel cells and electrochemical capacitors seems to be extremely attractive.