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- (73) Patenthaver: **Seven King Energy Co., Ltd., (Kodengri 686) 24, Sojeongsandanseo-ro , Sojeong-myeon, Sejong-si, 30002, Sydkorea**
- (72) Opfinder: **KIM, Jae-Kwang, (Daehan Mansion, Dogye-dong), 603 14-15 Dogye-ro 83beon-gil, Uichang-gu, Changwon-si, Gyeongsangnam-do 51161, Sydkorea**
- (74) Fuldmægtig i Danmark: **Zacco Denmark A/S, Arne Jacobsens Allé 15, 2300 København S, Danmark**
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EP-A1- 1 049 188
JP-A- H09 505 932
KR-A- 20010 066 272
KR-A- 20020 085 942
KR-A- 20150 018 559
KR-B1- 100 368 438
KR-B1- 101 387 855
US-A1- 2010 151 335
US-A1- 2014 154 586

DESCRIPTION

[Technical Field]

[0001] The present invention relates to a composite electrolyte for a secondary battery, and more particularly, to a composite electrolyte for a secondary battery, having a multi-layer structure, in which the composite electrolyte is configured to have a multi-layer including two or more layers, thereby improving stability and electrochemical characteristics.

[Background Art]

[0002] The application fields of a secondary battery that can be charged and discharged have been expanding from portable devices such as mobile phones, laptop computers, and camcorders to electric vehicles day by day, and accordingly, the secondary battery has been actively developed. Further, research and development on the design of the secondary battery have also been conducted in order to improve the capacity density and the specific energy at the time of developing the secondary battery.

[0003] In general, the secondary battery is composed of a cathode part, an anode part, and an electrolyte and a polymer separator positioned therebetween.

[0004] In particular, as an electrolyte for an electrochemical device in the prior art, a liquid-state electrolyte, particularly, an ion-conductive organic liquid electrolyte in which a salt is dissolved in a non-aqueous organic solvent has been mainly used. However, the liquid-state electrolyte has a problem in that the flammability and low thermal stability of the liquid-state electrolyte degrade the stability of the lithium secondary battery.

[0005] In order to solve the problem and improve the stability of a lithium secondary battery, various electrolytes such as a ceramic solid electrolyte and a polymer electrolyte have been developed.

[0006] However, the ceramic solid electrolyte and the polymer electrolyte have low ion conductivity at room temperature and low interface resistance characteristics with electrodes, and thus have another problem of making electrochemical characteristics of a secondary battery deteriorate.

[0007] In order to solve the problem, there have been attempts to manufacture a composite electrolyte by mixing ceramic particles with a polymer and manufacture a solid-phase composite electrolyte by including a small amount of a liquid electrolyte in the composite electrolyte.

[0008] The thus manufactured composite electrolyte increases thermal stability, and further, decreases the interface resistance, and the composite electrolyte includes a lithium ion-activated ceramic and thus increases electrochemical characteristics by improving the transfer of lithium ions.

[0009] However, since a ceramic and a polymer used in a composite electrolyte have different characteristics in a cathode part and an anode part of a secondary battery according to the types of ceramic and polymer, there is a limitation in improving stability and electrochemical characteristics.

[0010] As a prior art document related to the present invention, there is Korean Patent Application Laid-Open No. 10-2013-0111833 (October 11, 2013), and the prior art document discloses an electrolyte for a lithium ion secondary battery, having a multi-layer structure, the lithium ion secondary battery including a cathode and an anode. Documents US2014/154586 A1 and KR100 368 438 B1 are disclosing composite electrolytes for lithium ion batteries.

[Disclosure]

[Technical Problem]

[0011] An object of the present invention is to provide a composite electrolyte for a secondary battery, which can simultaneously satisfy characteristics of a cathode part and an anode part as an electrolyte layer positioned toward the cathode part and an electrolyte layer positioned toward the anode part are formed of different materials and laminated as a multi-layer structure.

[Technical Solution]

[0012] A composite electrolyte for a secondary battery, having a multi-layer structure, according to the present invention is a composite electrolyte for a secondary battery, and the composite electrolyte includes: a first electrolyte layer positioned toward a cathode part; and a second electrolyte layer positioned toward an anode part, in which each of the first electrolyte layer and the second electrolyte layer includes a polymer base and ion-conductive ceramic particles, and a liquid electrolyte, the liquid electrolyte being included in an amount of 1 to 50 parts by weight based on 100 parts by weight of the total composite electrolyte, the ceramic particles of the first electrolyte layer and those of the second electrolyte layer are different from each other, and the first electrolyte layer and the second electrolyte layer are formed of different materials.

[0013] Further, the composite electrolyte for a secondary battery, having a multi-layer

structure, according to the present invention includes a third electrolyte layer positioned between the first electrolyte layer and the second electrolyte layer, in which the third electrolyte layer includes a polymer base and ceramic particles.

[0014] Furthermore, the first electrolyte layer according to the present invention has relatively better electric stability at the cathode part as compared to the second electrolyte layer, and the second electrolyte layer has relatively better electric stability at the anode part as compared to the first electrolyte layer.

[0015] Further, each of the first electrolyte layer and the second electrolyte layer according to the present invention includes a different polymer base.

[0016] In addition, the polymer base according to the present invention includes one or more selected from the group consisting of a polyvinylidene fluoride-based polymer, a polyethylene glycol-based polymer, a polyacrylonitrile-based polymer, a polymethylmethacrylate-based polymer, a polyvinyl chloride-based polymer, a polyvinylpyrrolidone-based polymer, a polyimide-based polymer, a polyethylene-based polymer, a polyurethane-based polymer, a polypropylene-based polymer, a polypropylene oxide-based polymer, a polyethylene imine-based polymer, a polyethylene sulfide-based polymer, a polyvinyl acetate-based polymer, a polyethylenesuccinate-based polymer, a polyester-based polymer, a polyamine-based polymer, a polysulfide-based polymer, a siloxane-based polymer, derivatives thereof, and combinations thereof.

[0017] Each of the first electrolyte layer and the second electrolyte layer according to the present invention includes different ceramic particles.

[0018] Further, the ceramic particles according to the present invention include one or more selected from the group consisting of Al_2O_3 -based ceramic particles, SiO_2 -based ceramic particles, BaTiO_3 -based ceramic particles, TiO_2 -based ceramic particles, lithium oxide-based ceramic particles, lithium sulfide-based ceramic particles, an amorphous ion conductive material, NASICON, sodium sulfide-based ceramic particles, sodium oxide-based ceramic particles, derivatives thereof, and combinations thereof.

[Advantageous Effects]

[0019] In order to improve the stability of a secondary battery in the prior art, a solid-phase electrolyte was manufactured of only a polymer or a ceramic, a ceramic-polymer composite electrolyte was manufactured in only one layer. However, the polymer electrolyte has low ion conductivity at room temperature, the ceramic solid electrolyte has a large interface resistance with an electrode, and the ceramic-polymer composite electrolyte cannot simultaneously satisfy characteristics of a cathode and an anode of a secondary battery.

[0020] On the other hand, a composite electrolyte for a secondary battery, having a multi-layer structure, as defined in claim 1, has high ion conductivity and has effects capable of reducing an interface resistance with an electrode and simultaneously satisfying characteristics of a cathode part and an anode part.

[0021] Further, the composite electrolyte has advantages in that the thermal stability is excellent, the capacity is excellent when the composite electrolyte is applied to a secondary battery, and as the charge-discharge cycle proceeds, the capacity is maintained without being significantly reduced.

[Description of Drawings]

[0022]

FIG. 1 is a view for schematically illustrating a cross-sectional structure of a composite electrolyte for a secondary battery, having a double-layer structure, according to the present invention.

FIG. 2 is a view for schematically illustrating a cross-sectional structure of a composite electrolyte for a secondary battery, having a triple-layer structure, according to the present invention.

FIG. 3 is a SEM analysis photograph of a surface of a composite electrolyte for a secondary battery, having a multi-layer structure, according to the present invention.

FIG. 4 is a SEM analysis photograph of a cross-section of the composite electrolyte for a secondary battery, having a multi-layer structure, according to the present invention.

FIGS. 5A and 5B are views for illustrating deformation characteristics of the composite electrolyte for a secondary battery, having a multi-layer structure, according to the present invention.

FIGS. 6A and 6B are photographs for testing the thermal stability of the composite electrolyte for a secondary battery, having a multi-layer structure, according to the present invention.

FIGS. 7A and 7B are photographs for testing the thermal stability of a commercially available separator for a secondary battery in the prior art.

FIG. 8A is a charge-discharge curve of the composite electrolyte for a secondary battery, having a multi-layer structure, according to the present invention.

FIG. 8B is a charge-discharge curve of a composite electrolyte for a secondary battery in the prior art.

[Best Mode]

[0023] Hereinafter, preferred Examples according to the present invention will be described in detail with reference to the accompanying drawings.

[0024] The benefits and features of the present invention, and the methods of achieving the benefits and features will become apparent with reference to Examples to be described below in detail along with the accompanying drawings.

[0025] However, the present invention is not limited to the Examples to be disclosed below, but may be implemented in various other forms, and the present Examples are only provided for rendering the disclosure of the present invention complete and for fully representing the scope of the invention to a person with ordinary skill in the technical field to which the present invention pertains, and the present invention is defined only by the scope of the claims.

[0026] FIG. 1 is a view for schematically illustrating a cross-sectional structure of a composite electrolyte for a secondary battery, having a double-layer structure, according to the present invention.

[0027] Referring to FIG. 1, a composite electrolyte 100 for a secondary battery, having a double-layer structure, according to the present invention is used in a secondary battery including a cathode part and an anode part, and includes a first electrolyte layer 110 positioned toward the cathode part and a second electrolyte layer 120 positioned toward the anode part.

[0028] In this case, each of the first electrolyte layer 110 and the second electrolyte layer 120 includes a polymer base 10 and ceramic particles 20 distributed in the polymer base 10, in which the first electrolyte layer 110 and the second electrolyte layer 120 are formed of different materials.

[0029] In general, the ceramic particles 20 and the polymer base 10 used in a composite electrolyte for a secondary battery have different characteristics in a cathode part and an anode part of a secondary battery according to the types of the ceramic particles 20 and the polymer base 10, so that there is a problem in that electrochemical characteristics deteriorate.

[0030] When a composite electrolyte having a single-layer structure is used, one electrolyte layer is brought into contact with a cathode part and an anode part, and the one electrolyte layer exhibits different characteristics in the cathode part and the anode part, so that there is limitation in improving the stability and electrochemical characteristics of a secondary battery.

[0031] On the other hand, the present invention intends to improve the stability and electrochemical characteristics of a secondary battery by complexing the different ceramic particles 20 and the different polymer bases 10, such that the electrolytes brought into contact

with the cathode part and the anode part have different materials, thereby manufacturing a composite electrolyte having a multi-layer structure including two or more layers.

[0032] FIG. 2 is a view for schematically illustrating a cross-sectional structure of a composite electrolyte for a secondary battery, having a triple-layer structure, according to the present invention.

[0033] Referring to FIG. 2, the composite electrolyte 100 for a secondary battery, having a multi-layer structure, according to the present invention is used in a secondary battery including a cathode part and an anode part, and the composite electrolyte 100 includes the first electrolyte layer 110 positioned toward the cathode part and the second electrolyte layer 120 positioned toward the anode part, and further includes a third electrolyte layer 130 positioned between the first electrolyte layer 110 and the second electrolyte layer 120.

[0034] Each of the electrolyte layers includes the polymer base 10 and the ceramic particles 20 distributed in the polymer base 10, in which the first electrolyte layer 110 positioned toward the cathode part and the second electrolyte layer 120 positioned toward the anode part are formed of different materials.

[0035] In this case, it is preferred that the first electrolyte layer 110 has relatively better electric stability at the cathode part as compared to the second electrolyte layer 120, and the second electrolyte layer 120 has relatively better electric stability at the anode part as compared to the first electrolyte layer 110.

[0036] In addition, it is possible to further improve electrochemical characteristics of a secondary battery by complexing various ceramic characteristics through the third electrolyte layer 130.

[0037] In order to realize characteristics of a secondary battery to be used or characteristics of a desired composite electrolyte in addition to the aforementioned structures, it is possible to add a plurality of electrolyte layers between the first electrolyte layer 110 and the second electrolyte layer 120, and accordingly, it is possible to realize a composite electrolyte for a secondary battery, having a multi-layer structure. The multi-layer structure may include both the double-layer structure and the triple-layer structure described above.

[0038] In order to manufacture the aforementioned multi-layer structure, it is possible to use a typically known manufacturing method such as a printing method, a doctor blade method, a phase separation method, an electrospinning method, an extraction method, and a compression method.

[0039] The composite electrolyte for a secondary battery, having a multi-layer structure, according to the present invention additionally includes a small amount of a liquid electrolyte.

[0040] The liquid electrolyte may be a liquid electrolyte obtained by dissolving one or more

lithium salts selected from the group consisting of LiBF_4 , LiClO_4 , LiPF_6 , LiSbF_6 , LiAsF_6 , $\text{Li}(\text{C}_2\text{F}_5\text{SO}_3)_2\text{N}$, LiCF_3SO_3 , $\text{Li}(\text{CF}_3\text{SO}_2)_2\text{N}$, $\text{LiC}_4\text{F}_9\text{SO}_3$, $\text{Li}(\text{CF}_3\text{SO}_2)_3\text{C}$, LiBPh_4 , LiAlO_4 , LiAlCl_4 , LiSCN , and $\text{Li}(\text{CF}_3\text{SO}_2)_3$ in a cyclic carbonate-based organic solvent such as ethylene carbonate, propylene carbonate, 1,2-butylene carbonate, 2,3-butylene carbonate, and 2,3-pentylene carbonate and a linear carbonate-based organic solvent such as dimethyl carbonate, diethyl carbonate, ethylmethyl carbonate, 1,2-dimethoxyethane, dipropyl carbonate, methylpropyl carbonate, and ethylpropyl carbonate, but is not limited thereto, and may include all types of liquid electrolytes typically used in the art.

[0041] The liquid electrolyte is included in an amount of 1 to 50 parts by weight based on 100 parts by weight of the total composite electrolyte, and the liquid electrolyte may be introduced into the composite electrolyte through an impregnation process.

[0042] As a method of impregnating a liquid electrolyte, it is also possible to use a method of impregnating a liquid electrolyte after each of the electrolyte layers is separately manufactured or a method of impregnating an entire composite electrolyte having a multi-layer structure.

[0043] The thus impregnated liquid electrolyte may decrease the interface resistance between an electrode and an electrolyte, and may also decrease the interface resistance between the ceramic particles 20 and the polymer base 10 in the composite electrolyte. Each of the first electrolyte layer 110 and the second electrolyte layer 120 is not limited to include the same polymer base 10, but it is preferred that each of the first electrolyte layer 110 and the second electrolyte layer 120 includes the different polymer base 10.

[0044] Here, the polymer base 10 includes one or more selected from the group consisting of a polyvinylidene fluoride (PVdF)-based polymer, a polyethylene glycol (PEO)-based polymer, a polyacrylonitrile (PAN)-based polymer, a polymethylmethacrylate (PMMA)-based polymer, a polyvinyl chloride-based polymer, a polyvinylpyrrolidone (PVP)-based polymer, a polyimide (PI)-based polymer, a polyethylene (PE)-based polymer, a polyurethane (PU)-based polymer, a polypropylene (PP)-based polymer, a polypropylene oxide (PPO)-based polymer, a polyethylene imine (PEI)-based polymer, a polyethylene sulfide (PES)-based polymer, a polyvinyl acetate (PVAc)-based polymer, a polyethylenesuccinate (PESc)-based polymer, a polyester-based polymer, a polyamine-based polymer, a polysulfide-based polymer, a siloxane-based polymer, derivatives thereof, and combinations thereof.

[0045] Each of the first electrolyte layer 110 and the second electrolyte layer 120 includes the different ceramic particles 20.

[0046] Here, the ceramic particles 20 include one or more selected from the group consisting of Al_2O_3 -based ceramic particles, SiO_2 -based ceramic particles, BaTiO_3 -based ceramic particles, TiO_2 -based ceramic particles, lithium oxide-based ceramic particles, lithium sulfide-based ceramic particles, an amorphous ion conductive material, NASICON, sodium sulfide-based ceramic particles, sodium oxide-based ceramic particles, derivatives thereof, and

combinations thereof.

[0047] In this case, the lithium oxide-based ceramic particles may include $\text{Li}_{1.3}\text{Al}_{0.3}\text{Ti}_{1.7}(\text{PO}_4)_3$ (LTAP), $\text{Li}_7\text{La}_3\text{Zr}_2\text{O}_{12}$ (LLZO), or the like, the lithium sulfide-based ceramic particles may include $\text{Li}_{10}\text{GeP}_2\text{S}_{12}$, $\text{Li}_2\text{S-P}_2\text{S}_5$, or the like, and the amorphous ion conductive material may include phosphorus-based glass, oxide-based glass, oxide/sulfide-based glass, or the like.

[0048] A polyethylene glycol (PEO)-based polymer is stable at the side of the anode part, but instable at the side of the cathode part, and a $\text{Li}_{1.3}\text{Al}_{0.3}\text{Ti}_{1.7}(\text{PO}_4)_3$ (LTAP) ceramic solid electrolyte has a problem in that an anode with a low voltage, such as graphite, Si, and Li, cannot be used due to the high reduction potential of Ti, but may increase electrochemical characteristics of a composite electrolyte due to the excellent lithium ion activity.

[0049] For example, the first electrolyte layer 110 according to the present invention may be complexed by using polyvinylidene fluoride (PVdF) having high electric stability as the polymer base 10 and using LTAP as the ceramic particles 20, and the second electrolyte layer 120 according to the present invention may be complexed by using polyvinylidene fluoride (PVdF) having high electric stability or a polyethylene glycol (PEO)-based polymer having high stability at the anode part as the polymer base 10 and using LLZO or Al_2O_3 , which is stable at low voltage, as the ceramic particles 20, but the complexing method is not limited thereto.

[0050] The third electrolyte layer 130 according to the present invention may be complexed by using a polyethylene glycol (PEO)-based polymer as the polymer base 10 and using lithium sulfide-based ceramic particles such as $\text{Li}_2\text{S-P}_2\text{S}_5$ as the ceramic particles 20, but the complexing method is not limited thereto.

[0051] FIG. 3 is a SEM analysis photograph of a surface of a composite electrolyte for a secondary battery, having a multi-layer structure, according to the present invention, and FIG. 4 is a SEM analysis photograph of a cross-section of the composite electrolyte for a secondary battery, having a multi-layer structure, according to the present invention.

[0052] Referring to FIGS. 3 and 4, it can be seen that in the composite electrolyte for a secondary battery, having a multi-layer structure, according to the present invention, the ceramic particles and the polymer base are mixed well, such that the surface thereof is formed very uniformly, and that the bond between the electrolyte layers is formed firmly.

[0053] FIGS. 5A and 5B are views for illustrating deformation characteristics of the composite electrolyte for a secondary battery, having a multi-layer structure, according to the present invention, and as illustrated, it can be seen that the variability is very excellent.

[0054] FIG. 6A is a photograph for testing the thermal stability of a commercially available separator for a second battery in the prior art, and FIG. 6B is a photograph for testing the

thermal stability of the composite electrolyte for a secondary battery, having a multi-layer structure, according to the present invention.

[0055] Referring to FIGS. 6A and 6B, it can be seen that the composite electrolyte for a secondary battery, having a multi-layer structure, according to the present invention has no flammability and exhibits excellent thermal stability in which the composite electrolyte does not shrink even at 120°C, whereas the commercially available separator is burnt well in fire and significantly shrinks at 120°C.

[0056] FIG. 7A is a charge-discharge curve of the composite electrolyte for a secondary battery, having a multi-layer structure, according to the present invention, and FIG. 7B is a charge-discharge curve of a composite electrolyte for a secondary battery in the prior art.

[0057] Here, in the composite electrolyte for a secondary battery, having a multi-layer structure, according to the present invention, which is illustrated in FIG. 7A, a first electrolyte layer positioned toward a cathode part was manufactured by mixing LTAP and PVdF at a weight ratio of 80 : 20, and a second electrolyte layer positioned toward an anode part was manufactured by mixing LLZO and PVdF at a weight ratio of 80 : 20, and printing, phase separation, and doctor blade methods were used as a method of manufacturing a film. A liquid electrolyte corresponding to 10 parts by weight based on 100 parts by weight of the entire composite electrolyte was impregnated into the thus manufactured composite electrolyte.

[0058] In order to analyze electrochemical characteristics of a secondary battery in which a composite electrolyte was used, the secondary battery was charged-discharged at room temperature and a current density of 0.1 C by using LiCoO_2 as a cathode and using a Li metal having the lowest potential as an anode.

[0059] For the composite electrolyte for a secondary battery in the prior art illustrated in FIG. 7B, the composite electrolyte is composed of a single mixture having a triple-layer structure including PEO/LTAP/PEO.

[0060] As illustrated, it can be seen that the LiCoO_2 cathode exhibits a capacity of up to 170 mAh/g, but the composite electrolyte for a secondary battery, having a multi-layer structure, according to the present invention has a capacity of 160 mAh/g. The change in capacity is not significant even though the charge-discharge cycle is repeated, whereas in the composite electrolyte for a secondary battery in the prior art, the capacity is continuously decreased as the charge-discharge cycle is repeated. As a result, it can be seen that the electrochemical characteristics of the composite electrolyte for a secondary battery, having a multi-layer structure, according to the present invention are excellent.

[0061] Although the specific Examples of the composite electrolyte for a secondary battery according to the present invention have been described so far, it is obvious that various modifications can be made without departing from the scope of the present invention.

[0062] Therefore, the scope of the present invention should not be limited to the described Examples, and should be defined by the appended claims.

REFERENCES CITED IN THE DESCRIPTION

Cited references

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- KR1020130111833 [0010]
- US2014154586A1 [0010]
- KR100368438B1 [0010]

Patentkrav

1. Kompositelektrolyt til et sekundært Li-ion-batteri, som har en flerlagsstruktur, hvilken kompositelektrolyt omfatter:

et første elektrolyttag positioneret mod en katodedel;
5 og et andet elektrolyttag positioneret mod en anodedel,
hvor hvert af det første elektrolyttag og det andet elektrolyttag omfatter en polymerbase og ionledende keramiske partikler, og
en flydende elektrolyt, hvor den flydende elektrolyt er inkluderet i en mængde
10 på 1 til 50 vægtdele baseret på 100 vægtdele af den totale kompositelektrolyt,
de keramiske partikler af det første elektrolyttag og de af det andet
elektrolyttag er forskellige fra hinanden,
og det første elektrolyttag og det andet elektrolyttag er dannet af forskellige materialer.

2. Kompositelektrolytten ifølge krav 1, omfattende:

et tredje elektrolyttag positioneret mellem det første elektrolyttag og det andet elektrolyttag, hvor det tredje elektrolyttag omfatter en polymerbase og keramiske partikler.

3. Kompositelektrolytten ifølge krav 1, hvor hvert af det første elektrolyttag og det andet elektrolyttag omfatter en forskellig polymerbase.

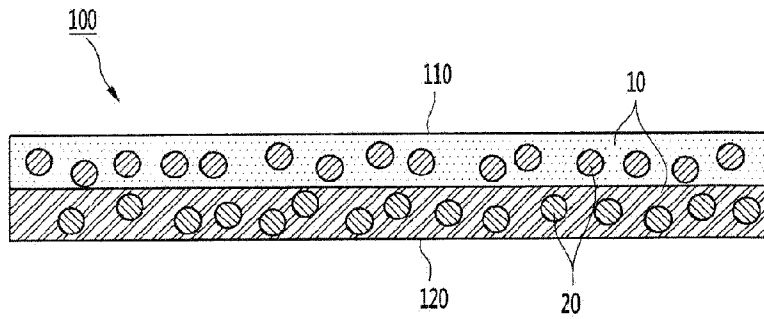
4. Kompositelektrolytten ifølge krav 3, hvor polymerbasen omfatter en eller flere valgt
25 fra gruppen bestående af en polyvinylidenfluorid-baseret polymer, en polyethylenglycol-baseret polymer, en polyakrylonitril-baseret polymer, en polymethylmethakrylat-baseret polymer, en polyvinylchlorid-baseret polymer, en polyvinylpyrrolidon-baseret polymer, en polyimid-baseret polymer, en polyethylen-baseret polymer, en polyurethan-baseret polymer, en polypropylen-baseret polymer,
30 en polypropylenoxid-baseret polymer, en polyethylenimin-baseret polymer, en polyethylensulfid-baseret polymer, en polyvinylacetat-baseret polymer, en polyethylensuccinat-baseret polymer, en polyester-baseret polymer, en polyamin-baseret polymer, en polysulfid-baseret polymer, en siloxan-baseret polymer,

derivater deraf og kombinationer deraf.

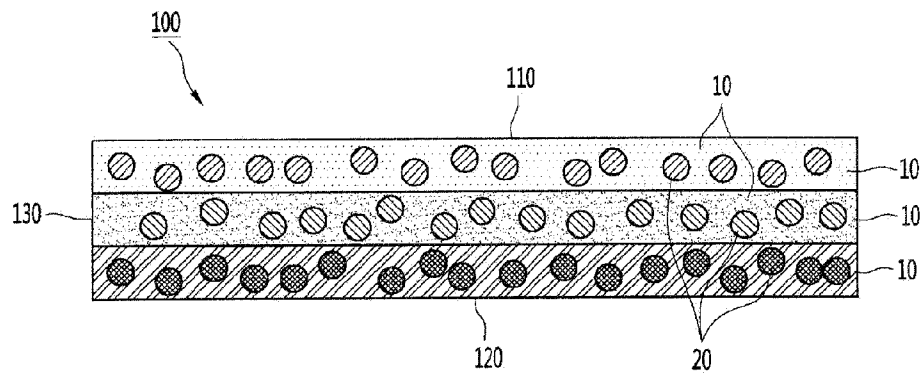
- 5.** Kompositelektrolytten ifølge krav 1 eller 2, hvor de keramiske partikler omfatter en eller flere valgt fra gruppen bestående af Al_2O_3 -baseret keramiske partikler, SiO_2 -baseret keramiske partikler, BaTiO_3 -baseret keramiske partikler, TiO_2 -baseret keramiske partikler, litiumoxid-baseret keramiske partikler, litiumsulfid-baseret keramiske partikler, et amorft ionledende materiale, NASICON, natriumsulfid-baseret keramiske partikler, natriumoxid-baseret keramiske partikler, derivater deraf og kombinationer deraf.

DRAWINGS

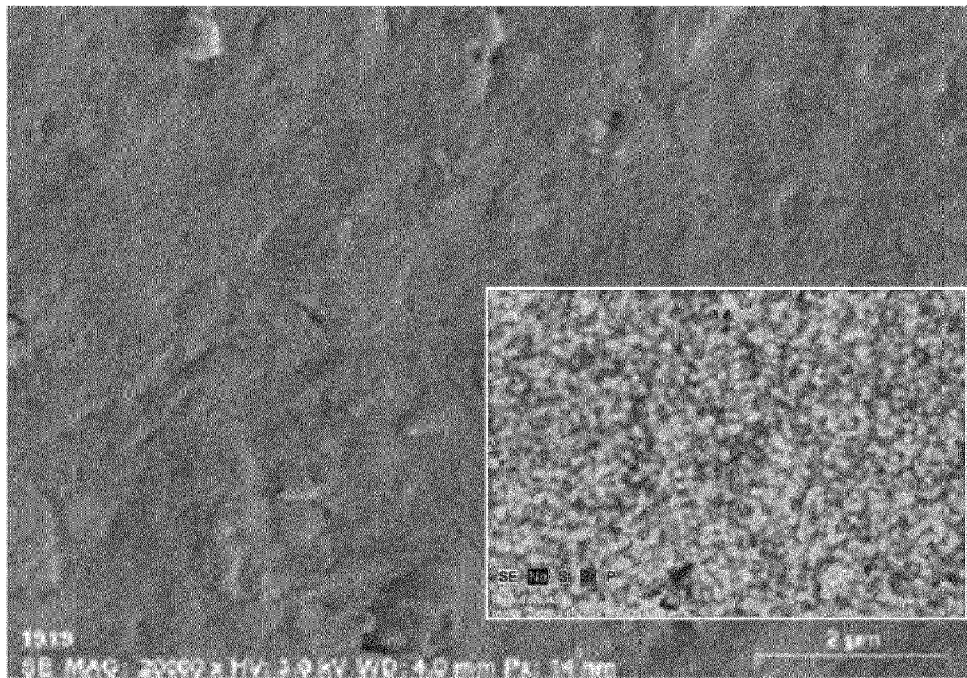
[Fig. 1]



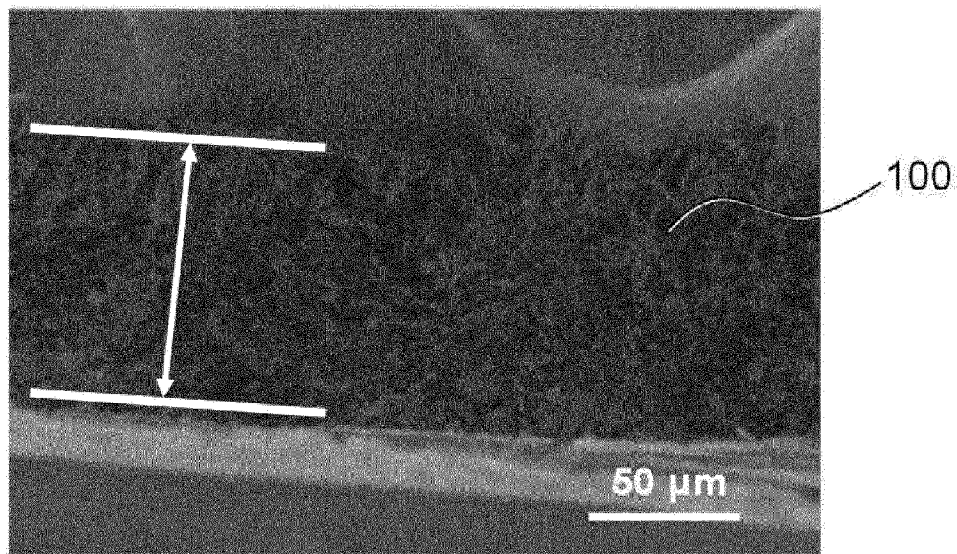
[Fig. 2]



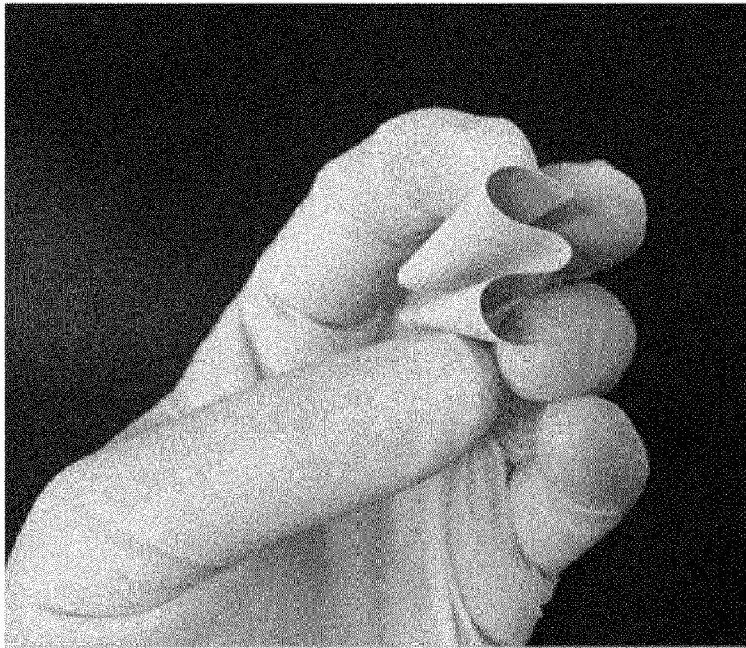
[Fig. 3]



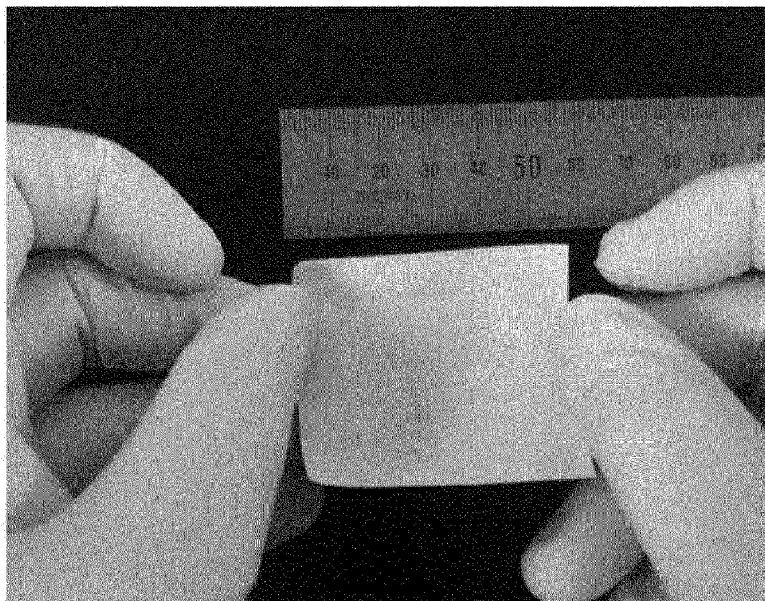
[Fig. 4]



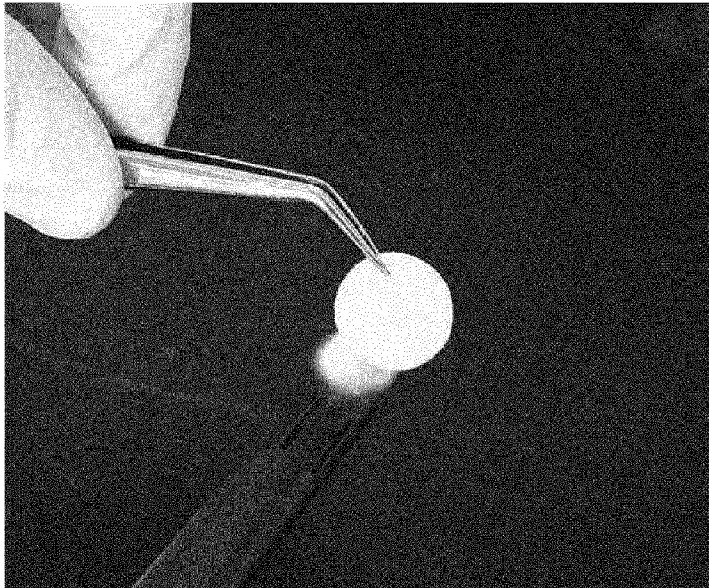
[Fig. 5a]



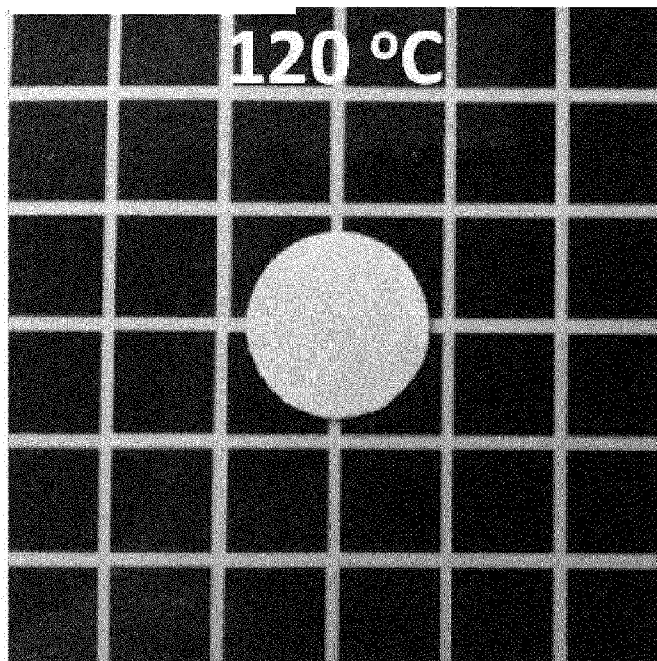
[Fig. 5b]



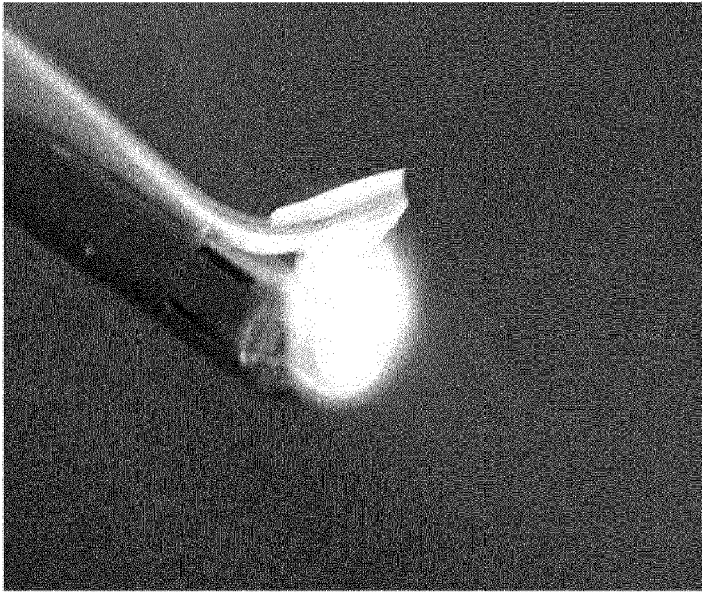
[Fig. 6a]



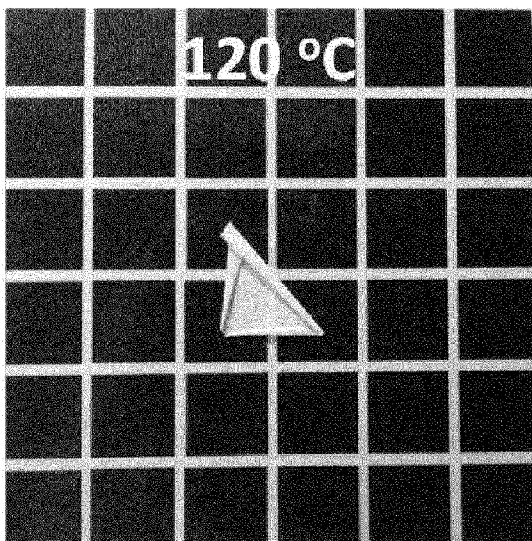
[Fig. 6b]



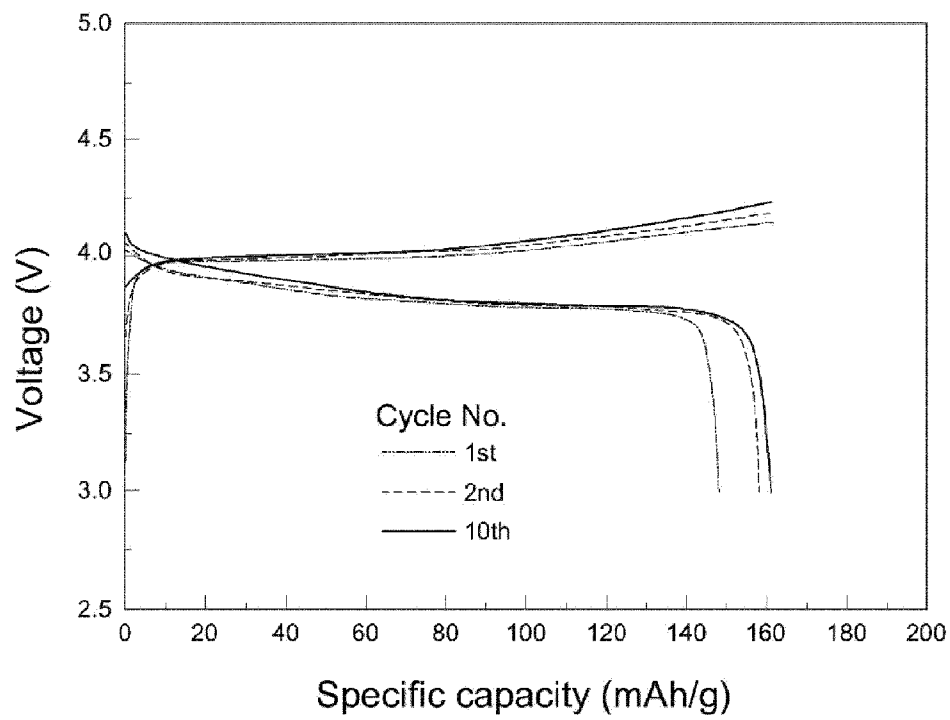
[Fig. 7a]



[Fig. 7b]



[Fig. 8a]



[Fig. 8b]

