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**Adams et al.**

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(45) **Date of Patent: Oct. 3, 2017**

(54) **ELECTRODE MATERIALS FOR RECHARGEABLE ZINC CELLS AND BATTERIES PRODUCED THEREFROM**

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(72) Inventors: **Brian D. Adams**, Mitchell (CA); **Dipan Kundu**, Kitchener (CA)

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(51) **Int. Cl.**

| | |
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| ***H01M 4/62*** | (2006.01) |
| ***H01M 4/485*** | (2010.01) |
| ***H01M 10/36*** | (2010.01) |

(52) **U.S. Cl.**

CPC ..... ***H01M 10/36*** (2013.01); ***H01M 4/485*** (2013.01); ***H01M 4/623*** (2013.01); ***H01M 4/625*** (2013.01); ***H01M 4/661*** (2013.01); ***H01M 4/663*** (2013.01); *H01M 2300/0002* (2013.01)

(58) **Field of Classification Search**

CPC ..... H01M 10/36; H01M 4/50; H01M 4/244; H01M 4/485; H01M 4/66; H01M 4/62

See application file for complete search history.

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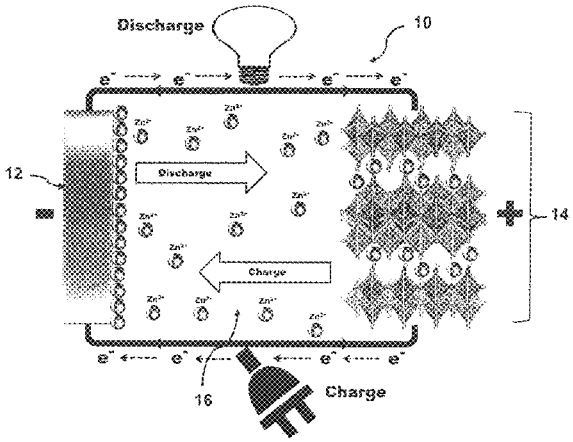
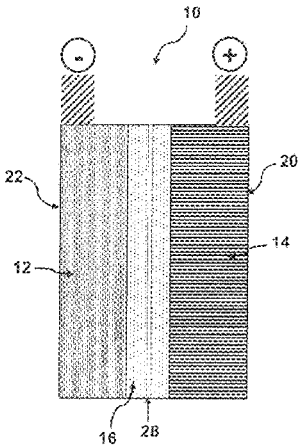
(57) **ABSTRACT**

The present disclosure discloses a rechargeable Zn battery based on layered/tunnelled structure vanadium/molybdenum oxides, with/without the presence of neutral/cationic/anionic species and/or water molecules inserted into the interlayers/tunnels, of nano/microparticle morphology as robust materials for high rate and long term reversible $Zn^{2+}$ ion intercalation storage at the positive electrode, that are coupled with a metallic Zn negative electrode, and an aqueous electrolyte. The positive electrode may include electronically conducting additives and one or more binders along with the $Zn^{2+}$ intercalation material: the negative electrode is Zn metal in any form; the aqueous electrolyte is of pH 1 to 9 and contains a soluble zinc salt in a concentration range from 0.01 to 10 molar.

**16 Claims, 14 Drawing Sheets**



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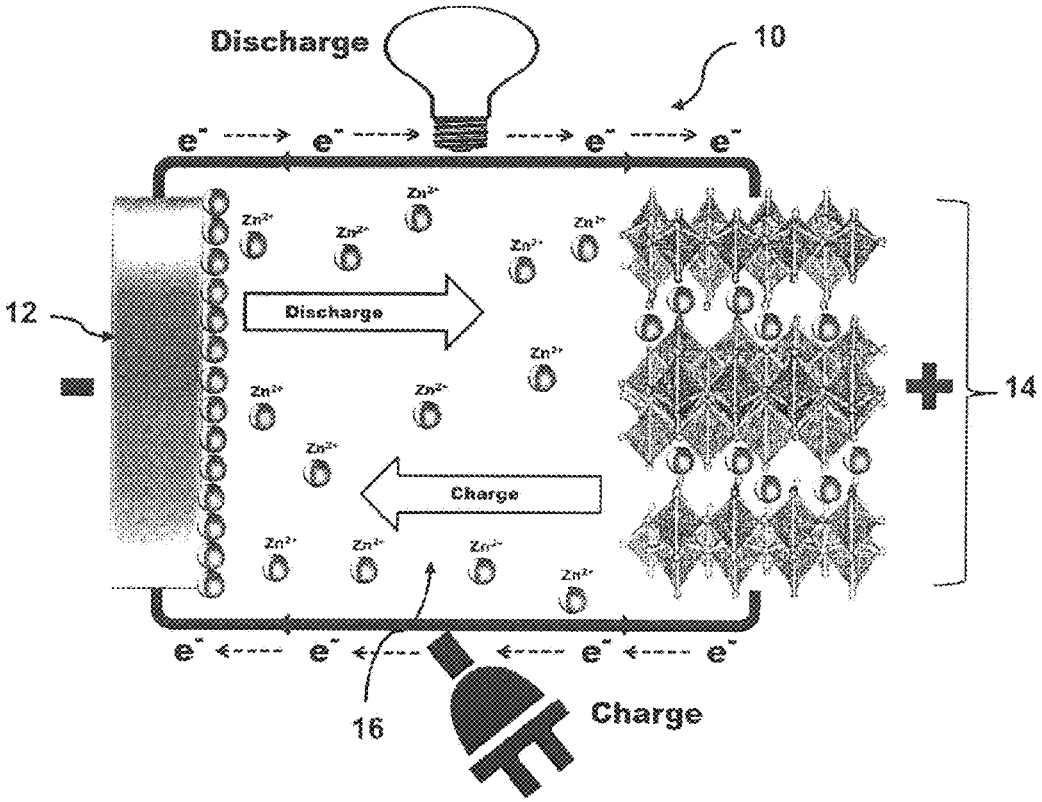


Figure 1A

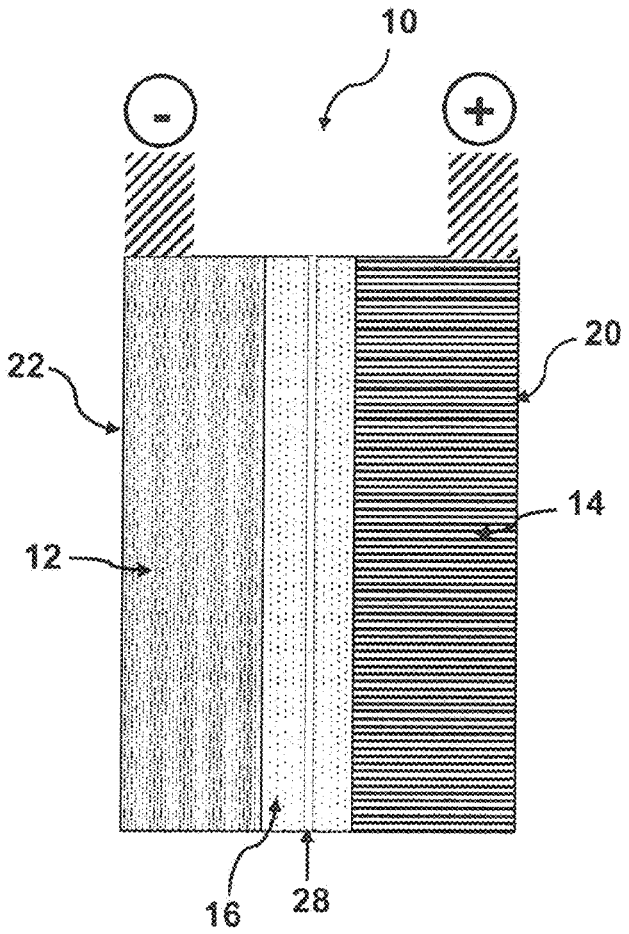


Figure 1B

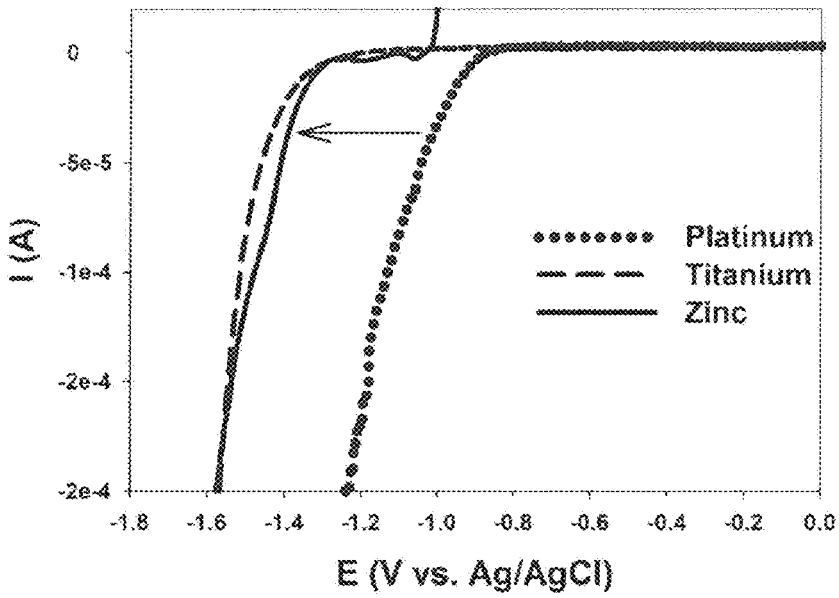


Figure 2

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