What is claimed is:

1. An electrochemical cell comprising:

a first liquid phase defining a positive electrode comprising a first element and a second element, the first and second elements being other than an alkali metal;

a second liquid phase defining an electrolyte comprising cations of an active alkali metal, the second liquid phase defining a first interface and a second interface, the first liquid phase being in contact with the second liquid phase at the first interface; and

a third liquid phase separated from the first liquid phase and defining a negative electrode comprising the active alkali metal in atomic form, the third liquid phase being in contact with the second liquid phase at the second interface; and

the first and second interfaces being separate, wherein

in a discharged state of the cell, the first liquid phase comprises the active alkali metal in atomic form and the first element includes antimony and the second element includes lead; and

in a charged state of the cell, the first liquid phase comprises antimony and lead in unchanged amounts compared to the discharged state of the cell and a loss of atoms of the active alkali metal, wherein the ratio of antimony to lead is chosen in a way that the composition of the first liquid phase is liquid at a temperature below 500°C independent of the state of the cell.

2. The electrochemical cell of claim 1, wherein in the charged state of the cell,

the first liquid phase is free of the active alkali metal in atomic form.

3. The electrochemical cell of claim 1,

wherein the ratio of antimony to lead is chosen in a range of 18mol% Sb : 82mol% Pb to 66.6mol% Sb : 33.3mol% Pb.

4. The electrochemical cell of claim 1,

wherein the ratio of antimony to lead is chosen as

18mol%Sb : 82mol% Pb or

30mol%Sb : 70mol% Pb or

40mol%Sb : 60mol% Pb or

66.6mol%Sb : 33.3mol% Pb.

5. The-electrochemical cell of claim 1, wherein the first liquid phase further comprises elements independently selected from group IVA, VA and VIA elements of the chemical periodic table.

6. The electrochemical cell of claim 5 wherein the further elements comprise at least one of tin, bismuth, tellurium and selenium.

7. The electrochemical cell of claim 1 wherein the active alkali metal is present at respective disparate chemical potentials in the first and third phases, originating a voltage between the first and third phases.

8. The electrochemical cell of claim 1 wherein the alkali metal is sodium or lithium.

9. A electrochemical cell of claim 1, wherein the second phase comprises a salt of the alkali metal selected from one or more of halide, bistriflimide, fluorosulfano-amine, perchlorate, hexaflourophosphate, tetrafluoroborate, carbonate or hydroxide.

10. The electrochemical cell of claim 1 further comprising an electrical pole electrically connected to the first phase, and an electrical pole electrically connected to the third phase.

11. A method of operating an electrochemical cell according to claim 1 using electrical energy transferred from an external circuit, the method comprising:

providing at least one electrochemical cell comprising

a first liquid phase defining a positive electrode comprising a first element and a second element other than an alkali metal;

a second liquid phase defining an electrolyte comprising cations of an active alkali metal, and defining a first interface and a second interface; the first liquid phase being in contact with the second liquid phase at the first interface; and

a third liquid phase separated from the first liquid phase and defining a negative electrode comprising the alkali metal in atomic form, and being in contact with the second liquid phase at the second interface and wherein the first and second interfaces are separate,

the device being configured to connect with the external circuit;

electrically connecting an external circuit to a negative pole and a positive pole of the electrochemical cell, wherein

antimony and lead are chosen as the first and second element of the first liquid phase defining the positive electrode, wherein the ratio of antimony to lead is chosen in a way that the composition of the first liquid phase is liquid at a temperature below 500°C during charging and discharging operation of the cell, and in that

operating the external circuit so as to produce or gain electrical energy in the electrochemical cell by driving transfer of the active alkali metal to or from the first liquid phase, through the second liquid phase, and to or from the third liquid phase, so that

in a discharged state of the cell, the first liquid phase comprises the active alkali metal in atomic form and antimony and lead in a certain amount; and

in a charged state of the cell, the first liquid phase comprises antimony and lead in unchanged amounts compared to the discharged state of the cell and a loss of atoms of the active alkali metal.

12. The method of claim 11 comprising sequentially electrically connecting an external source then an external load to the device.

13. The method of claim 11 wherein the electrochemical cell is part of a system to provide an uninterruptible power supply or the external circuit is an electric power plant, or a power transmission line, or delivers energy converted from a renewable energy source.

14. The method of claim 11, wherein the second phase comprises a halide salt of the active alkali metal and/or wherein the alkali metal is sodium or lithium.

15. A battery comprising two or more electrochemical cells according to claim 1 electrically connected in series and/or in parallel.

16. The electrochemical cell of claim 1, wherein the device has a total capacity of less than about 30 kWh.

17. The electrochemical cell of claim 1, wherein the electrochemical cell has a total capacity of greater than about 30 kWh.

Claims

1. An electrochemical cell comprising:

a positive electrode comprising a first liquid phase comprising lead and antimony;

a liquid electrolyte comprising a halide salt of an active alkali metal, the electrolyte defining a first interface and a second interface, the positive electrode being in contact with the electrolyte at the first interface; and

a negative electrode comprising a third liquid phase comprising the active alkali metal in atomic form, the negative electrode being in contact with the electrolyte at the second interface, the electrolyte configured to allow cations of the active alkali metal to be transferred from the negative electrode to the positive electrode during discharging and to be transferred from the positive electrode to the negative electrode during charging; and

the first and second interfaces being separate, wherein

in a discharged state of the cell, the positive electrode comprises the active alkali metal in atomic form and the antimony and lead; and

in a charged state of the cell, the positive electrode comprises the antimony and lead in unchanged amounts compared to the discharged state of the cell and a loss of atoms of the active alkali metal, wherein the composition of the first liquid phase is liquid at a temperature below 500°C.

2. The electrochemical cell of claim 1, wherein in the fully charged state of the cell,

the positive electrode is free of the active alkali metal in atomic form.

3. The electrochemical cell of claim 1, wherein the ratio of antimony to lead is chosen in a range of 18mol% Sb : 82mol% Pb to 66.6mol% Sb : 33.3mol% Pb.

4. The electrochemical cell of claim 1, wherein the ratio of antimony to lead is chosen as

18mol%Sb : 82mol% Pb or

30mol%Sb : 70mol% Pb or

40mol%Sb : 60mol% Pb or

66.6mol%Sb : 33.3mol% Pb.

5. The electrochemical cell of claim 1, wherein the positive electrode further comprises elements independently selected from group IVA, VA and VIA elements of the chemical periodic table.

6. The electrochemical cell of claim 5 wherein the further elements comprise at least one of tin, bismuth, tellurium and selenium.

7. The electrochemical cell of claim 1 wherein the active alkali metal is present at respective disparate chemical potentials in the first and third phases, originating a voltage between the positive electrode and the negative electrode.

8. The electrochemical cell of claim 1 wherein the alkali metal is sodium or lithium.

9. The electrochemical cell of claim 1 further comprising an electrical pole electrically connected to the first phase, and an electrical pole electrically connected to the third phase.

10. A method of operating an electrochemical cell according to claim 1 using electrical energy transferred from an external circuit, the method comprising:

providing at least one electrochemical cell comprising

a positive electrode comprising a first liquid phase comprising lead and antimony;

a liquid electrolyte comprising a halide salt of an active alkali metal, the electrolyte defining a first interface and a second interface; the positive electrode being in contact with the electrolyte at the first interface; and

a negative electrode comprising a third liquid phase comprising the active alkali metal in atomic form, and being in contact with the electrolyte at the second interface, the electrolyte configured to allow cations of the active alkali metal to be transferred from the negative electrode to the positive electrode during discharging and to be transferred from the positive electrode to the negative electrode during charging, and wherein the first and second interfaces are separate,

the device being configured to connect with the external circuit;

electrically connecting the external circuit to a negative pole and a positive pole of the electrochemical cell, wherein

the composition of the first liquid phase is liquid at a temperature below 600°C; and

operating the external circuit so as to produce or gain electrical energy in the electrochemical cell by to drivedriving transfer of the active alkali metal to or from the first liquid phase, through the electrolyte, and to or from the third liquid phase, so that

in a discharged state of the cell, the positive electrode comprises the active alkali metal in atomic form and the antimony and lead in a certain amount; and

in a charged state of the cell, the positive electrode comprises the antimony and lead in unchanged amounts compared to the discharged state of the cell and a loss of atoms of the active alkali metal.

11. The method of claim 10 comprising sequentially electrically connecting an external source then an external load to the electrochemical cell.

12. The method of claim 10 wherein the electrochemical cell is part of a system to provide an uninterruptible power supply or the external circuit is an electric power plant, or a power transmission line, or delivers energy converted from a renewable energy source.

13. The method of claim 10, wherein the active alkali metal is sodium or lithium.

14. A battery comprising two or more electrochemical cells according to claim 1 electrically connected in series and/or in parallel.

15. The electrochemical cell of claim 1, wherein the electrochemical cell has a total capacity of less than about 30 kWh.

16. The electrochemical cell of claim 1, wherein the electrochemical cell has a total capacity of greater than about 30 kWh.