CLAIMS

1. An electrical energy generating device, the device comprising at least one cell comprising:

first and second spaced electrodes, the first electrode comprising a low work function material and the second electrode comprising a high work function material; and

disposed between the first and second electrodes, beta particle emitting radionuclides and a semiconducting material comprising a semiconducting polymer or a semiconducting polymer composite, the semiconducting material capable of producing electron hole pairs in response to beta particle emission from the radionuclides.

2. The electrical energy generating device according to claim 1, wherein the radionuclides comprise one or more of ^{90}Sr, ^{99}Tc, ^{3}H, ^{14}C, ^{63}Ni, ^{137}Cs, ^{147}Pm, ^{151}Sm, ^{155}Eu, ^{93}Zr, ^{126}Sn, ^{60}Co, ^{210}Pb, ^{90}Y, ^{129}I, ^{188}W, ^{35}S, ^{123}Sn, ^{45}Ca, ^{106}Ru, ^{170}Tm, ^{171}Tm, ^{134}Cs, ^{32}Si, ^{113}Cd, and ^{79}Se.

3. The electrical energy generating device according to claims 1 or 2, wherein the low work function material comprises a metal and/or an intermetallic compound.

4. The electrical energy generating device according to any one of claims 1 to 3, wherein the low work function material comprises a metal and/or metal containing compound.

5. The electrical energy generating device according to claim 4, wherein the metal and/or metal containing compound comprises one or more of europium, strontium, barium, samarium, dysprosium, neodymium, gadolinium, terbium, holmium, erbium, thulium, lanthanum, scandium, thorium, calcium, magnesium, cerium, yttrium, ytterbium, sodium, lithium, potassium, rubidium, and cesium.

6. The electrical energy generating device according to any one of claims 1 to 5, wherein the low work function material comprises samarium metal.

7. The electrical energy generating device according to any one of claims 1 to 6, wherein the high work function material comprises a metal and/or intermetallic compound.

8. The electrical energy generating device according to any one of claims 1 to 7, wherein the high work function material comprises a metal selected from one or more of nickel, platinum, silver, gold, aluminium, cobalt, chromium, copper, beryllium, bismuth, cadmium, iron, gallium, germanium, mercury, indium, iridium, manganese, molybdenum, niobium, osmium, lead, palladium, rhenium, rhodium, ruthenium, antimony, silicon, tin, tantalum, technetium, titanium, vanadium, tungsten, zinc and zirconium.

9. The electrical energy generating device according to any one of claims 1 to 8, wherein the high work function material comprises nickel metal.

10. The electrical energy generating device according to any one of claims 1 to 9, wherein the second electrode comprises a ceramic metal composite.

11. The electrical energy generating device according to any one of claims 1 to 10, wherein the radionuclides are dispersed in the semiconducting material.

12. The electrical energy generating device according to any one of claims 1 to 11, wherein the radionuclides are incorporated into the chemical structure of the semiconducting material.

13. The electrical energy generating device according to any one of claims 1 to 12, wherein the semiconducting material comprises a single phase composite semiconducting material.

14. The electrical energy generating device according to claim 13, wherein the single phase composite semiconductor material comprises an inorganic semiconductor chemically complexed with a polymer.

15. The electrical energy generating device according to claim 14, wherein the inorganic semiconductor comprises one or more of cesium halide rubidium halide, potassium halide, lead halide, bismuth halide, antimony halide, arsenic halide, telurium halide, tin halide, a telluride of Zn, Cd, Hg, Ga, In, Tl, Ge, Sn, Pb, As, Sb, Bi, Se; a selenide of Zn, Cd, Hg, Ga, In, Tl, Ge, Sn, Pb, As, Sb, Bi, Te; and a sulfide of Zn, Cd, Hg, Ga, In, Tl, Ge, Sn, Pb, As, Sb, Bi, Se.

16. The electrical energy generating device according claims 14 or 15, wherein the polymer comprises one or more of a nylon, a polyimide, a polythiophene, a polypyrrole, a polyacrylonitrile, a polyurethane, a polycarbazole, a polyaniline, a polysulfide, a polysulfoxide, a polythioester, a polythiocarbonate, a polysulfate, a polythiourethane, a polysulfoximine, and a polysulfonium salt.

17. The electrical energy generating device according to claim 16, wherein the semiconducting polymer comprises one or more of a polythiophene, a polyacetylene, a polyphenylene vinylene, a polypyrrole polyphenylene sulphide, a polyaniline, a polyvinylacetylene, a polypyrrole, a polyindole, a poly vinylene, a poly azulene, and an organo-boron polymer.

18. The electrical energy generating device according to any one of claims 1 to 17, wherein the semiconducting material comprises a mixture of any two or three of a crystalline semiconductor, a semiconducting polymer and a semiconducting polymer composite.

19. The electrical energy generating device according to claim 18, wherein the crystalline semiconductor comprises one or more of a nitride, a carbide, a mixed chalcogenide, a telluride, a selenide, an antimonide, a germanide, an arsenide, a silicide, a phosphide, an aluminide, a carbon allotrope, a perovskite or other complex oxo-anion crystal phase material, a simple oxide, a doped oxide, a sulphide, a boride, and an intermetallic compound.

20. The electrical energy generating device according to claims 18 or 19, wherein

the crystalline semiconductor comprises one or more of a titanate, a zirconate, a molybdate, a vanadate, a technetate, a pertechnetate, a tungstate, a niobate, a tantalate, a doped tin oxide, a doped zinc oxide, a hafnate, a germanium oxide, a coblatate, a ferrate, and a manganate.

21. The electrical energy generating device according to any one of claims 18 to 20, wherein the semiconducting material comprises the crystalline semiconductor and a polymeric binder.

22. The electrical energy generating device according to any one of claims 1 to 21, wherein the first and second electrodes are separated by a distance in the range from 0.3 to 100 micrometres.

23. The electrical energy generating device according to any one of claims 1 to 22, wherein the device comprises a plurality of cells.

24. The electrical energy generating device according to claim 23, wherein the cells are electrically connected in series or in parallel.

25. A method of generating electricity, the method comprising using an electrical generating device according to any one of claims 1 to 24.

26. A method of generating electrical energy, the method comprising:

producing an electric potential difference between first and second closely spaced electrodes, the first electrode comprising a low work function material and the second electrode comprising a high work function material;

producing electron hole pairs from energetic beta particles emitted from radionuclides in close proximity with a semiconducting material comprising a semiconducting polymer or a semiconducting polymer composite, the semiconducting material disposed between the first and second electrodes, the electron hole pairs being mobile under the effect of an electric field between the electrodes; and

capturing the electron hole pairs into an external circuit using the electric field

existing between the electrodes;
thereby generating electrical energy.

27. A method of generating electrical energy, the method comprising:
producing an electric field between first and second spaced electrodes, the first electrode comprising a low work function material and the second electrode comprising a high work function material, and the electric field being produced due to different Schottky junctions at the two different electrodes;
producing electron hole pairs from energetic beta particles emitted from radionuclides in close proximity with a semiconducting material comprising a semiconducting polymer or a semiconducting polymer composite, the semiconducting material disposed between the first and second electrodes, the electron hole pairs being mobile under the effect of an electric field; and
capturing the electron hole pairs into an external circuit using the electric field existing between the electrodes;
thereby generating electrical energy.

28. A device for generating electrical energy using the method according to claim 27.

29. A product comprising a first material having a low work function, a second material having a high work function, and disposed between the first material and the second material beta particle emitting radionuclides and a semiconducting material comprising a semiconducting polymer or a semiconducting polymer composite, the semiconducting material capable of producing electron hole pairs in response to beta particle emission from the radionuclides.

30. A method of generating electrical energy, the method comprising using the product according to claim 29 in a device to generate the electrical energy.

31. A method of producing an electrical energy generating device, the method comprising incorporating one or more electrical cells into the electrical energy generating device, the one or more electrical cells comprising first and second spaced electrodes, the

first electrode comprising a low work function material and the second electrode comprising a high work function material, and disposed between the first and second electrodes, beta particle emitting radionuclides and a semiconducting material comprising a semiconducting polymer or a semiconducting polymer composite, the semiconducting material capable of producing electron hole pairs in response to beta particle emission from the radionuclides.