

CLAIMS

1. A method of accumulating radium radionuclides, comprising:
providing a first solution including thorium radionuclides and a thorium-binding
extractant, wherein the first solution does not bind to radium;
5 allowing a portion of the thorium radionuclides in the first solution to decay into radium
atoms; and
collecting radium atoms resulting from the decay.
2. The method of claim 1, wherein the thorium-binding extractant comprises TOPO (tri-
10 octyl phosphine Oxide).
3. The method of claim 1, wherein collecting the radium atoms comprises collecting the
radium atoms into a second solution.
- 15 4. The method of claim 1, wherein collecting the radium atoms comprises collecting the
radium atoms onto a brachytherapy source.
5. The method of claim 4, wherein collecting the radium atoms comprises collecting the
radium atoms into a second solution and dipping the brachytherapy source into the second
20 solution.
6. The method of claim 1, wherein providing the first solution comprises introducing the
first solution into a chamber with a second solution, such that the decay radium atoms diffuse into
the second solution.
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7. The method of claim 6, wherein providing the first solution comprises providing a
solution including a diluent having a low level of solubility with the second solution.
8. The method of claim 6, wherein the diluent has a specific weight lower than the specific
30 weight of water.
9. The method of claim 6, wherein the diluent comprises cyclohexane.
10. The method of claim 6, wherein the second solution comprises a salt solution.

11. The method of claim 1, wherein allowing a portion of the thorium radionuclides to decay into radium atoms comprises leaving the separation solution in a chamber with walls from a material which attracts radium for a decay period, and wherein collecting the radium atoms
5 comprises washing the radium atoms off the walls using a salt solution.

12. The method of claim 1, wherein allowing a portion of the thorium radionuclides in the separation solution to decay into radium atoms comprises placing the first solution in a chamber from which radium atoms are detachable without using an acid of pH lower than 4.
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13. The method of claim 1, wherein providing the first solution comprises:
providing a separation solution of a diluent having a low level of solubility and a thorium-binding extractant;
combining the prepared separation solution with an initial solution including thorium
15 radionuclides, so that thorium radionuclides from the initial solution bind to the thorium-binding extractant; and
separating the separation solution from the initial solution, to form the first solution.

14. A method of producing a brachytherapy source, comprising:
20 generating a solution including radium atoms; and
dipping a brachytherapy source into the solution, in a manner which collects the radium atoms onto the source.

15. The method of claim 14, and comprising coating the source with a protective coating
25 which prevents the radium atoms from detaching from the source, but allows daughter nuclei of the radium atoms to leave the source upon decay of the radium atoms.

16. The method of claim 15, wherein coating the source with a protective coating comprises coating by polysulfone or Polydimethylsiloxane.
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17. The method of claim 15, wherein coating the source with a protective coating comprises coating by alumina.

18. The method of claim 14, and comprising coating the source with manganese oxide prior to dipping the source in the solution.

19. The method of claim 18, and comprising heating the source and allowing it to slowly cool, after coating the source with manganese oxide.

20. The method of claim 14, wherein the source comprises a manganese oxide source.

21. The method of claim 14, wherein the solution comprises a salt solution.

22. The method of claim 14, wherein the solution comprises distilled water.

23. Apparatus for accumulating radium radionuclides, comprising:

a first vessel holding a first solution including thorium radionuclides and a thorium-binding extractant;

a second vessel holding a second solution including radium atoms;

a pump; and

a processor configured to control the pump to introduce a third solution into the first vessel, and after a sufficient period in which radium atoms are collected, to remove the third solution from the first vessel and transfer it to the second vessel.

24. A brachytherapy source, comprising:

a base sized and shaped for insertion into a human organ for brachytherapy;

a manganese oxide coating over the base; and

radium atoms attached to the manganese oxide coating.

25. The brachytherapy source of claim 24, wherein the base comprises a metal base.

26. The brachytherapy source of claim 24, wherein the base comprises a non-metal base.

27. The brachytherapy source of claim 24, further comprising a protective coating which prevents the radium atoms from detaching from the source, but allows daughter nuclei of the radium atoms to leave the source.

28. The brachytherapy source of claim 27, wherein the protective coating allows daughter nuclei of the radium atoms to leave the source due to energy resulting from decay of the radium atoms.

5 29. The brachytherapy source of claim 27, wherein the protective coating allows daughter nuclei of the radium to leave the source due to diffusion.

30. The brachytherapy source of claim 27, wherein the protective coating comprises polysulfone.

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31. The brachytherapy source of claim 27, wherein the protective coating comprises alumina.

32. The brachytherapy source of claim 24, wherein the brachytherapy source does not include more thorium atoms than 0.1% of the radium atoms on the source.

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33. The brachytherapy source of claim 24, wherein the radium atoms are attached to the manganese oxide coating in a manner resulting from annealing.