WHAT IS CLAIMED IS:

1. A method of performing chromatography with a gamma-irradiated chromatography resin, comprising:

(a) providing a chromatography column containing a gamma-irradiated chromatography resin;

(b) performing a first cycle of chromatography through the column, wherein the cycle includes exposing the chromatography resin to a denaturing buffer; and

(c) performing at least one additional cycle of chromatography through the column.

2. The method of claim 1, wherein performing the cycles in (b) and/or (c) comprises the steps of:

(a) capturing a recombinant protein by exposing the chromatography resin with a liquid containing a recombinant protein;

(b) washing the chromatography resin by exposing the chromatography resin with a wash buffer;

(c) eluting the recombinant protein by exposing the chromatography resin with an elution buffer; and

(d) regenerating the chromatography resin by exposing the chromatography resin to the denaturing buffer.

3. The method of claim 2, wherein the liquid containing a recombinant protein is a liquid culture medium.

4. The method of claim 1, wherein the cycles in (b) and (c) are performed using a closed and integrated system.

5. The method of claim 4, wherein the denaturing buffer is a reduced bioburden buffer.

6. The method of claim 5, wherein the reduced bioburden buffer is prepared by filtration.

7. The method of claim 1, wherein the denaturing buffer comprises one or more of urea, guanidine hydrochloride, and Triton™ X-100.

8. The method of claim 1, wherein the cycle of (b) further includes exposing the chromatography resin to wash buffer comprising about 0.5 M to about 1.5 M sodium hydroxide following exposure to the denaturing buffer.

9. The method of claim 1, wherein the column is part of a multi-column chromatography system (MCCS).

10. The method of claim 9, wherein the MCCS is a periodic counter current chromatography system (PCCS).

11. The method of claim 1, wherein the chromatography resin is anionic exchange chromatography resin, cationic exchange chromatography resin, size exclusion chromatography resin, hydrophobic interaction chromatography resin, affinity chromatography resin, or any combination thereof.

12. The method of claim 11, wherein the chromatography resin is anionic exchange chromatography resin.

13. The method of claim 1, wherein the chromatography resin has been treated with a dose of gamma-irradiation between about 10 kGy to about 40 kGy.

14. The method of claim 13, wherein the chromatography resin has been treated with a dose of gamma-irradiation between about 15 kGy to about 35 kGy.

15. The method of claim 14, wherein the chromatography resin has been treated with a dose of gamma-irradiation between about 20 kGy to about 30 kGy.

16. The method of claim 1, wherein four or more additional cycles of chromatography are performed.

17. The method of claim 16, wherein nine or more additional cycles of chromatography are performed.

18. The method of claim 17, wherein fourteen or more additional cycles of chromatography are performed.

19. The method of claim 18, wherein nineteen or more additional cycles of chromatography are performed.

20. The method of claim 19, wherein twenty-four or more additional cycles of chromatography are performed.

21. The method of claim 20, wherein twenty-nine or more additional cycles of chromatography are performed.

22. The method of claim 18, wherein thirty-nine or more additional cycles of chromatography are performed.

23. The method of claim 1, wherein (c) is performed continuously over a period of at least 4 days.

24. The method of claim 23, wherein (c) is performed continuously over a period of at least 5 days.

25. The method of claim 24, wherein (c) is performed continuously over a period of at least 7 days.

26. The method of claim 25, wherein (c) is performed continuously over a period of at least 14 days.

27. The method of claim 26, wherein (c) is performed continuously over a period of at least 28 days.

28. The method of claim 2, wherein the recombinant protein is a recombinant therapeutic protein.

29. An integrated, closed, and continuous process for manufacturing of a purified recombinant protein comprising:

(a) providing a liquid culture medium comprising a recombinant protein that is substantially free of cells; and

(b) continuously feeding the liquid culture medium into a multi-column chromatography system (MCCS) comprising at least one chromatography column containing gamma-irradiated chromatography resin, wherein the chromatography resin is exposed during each cycle to denaturing buffer;

wherein the process utilizes reduced bioburden buffer, is integrated, and runs continuously from the liquid culture medium to an eluate from the MCCS that is the purified recombinant protein.

30. The process of claim 29, wherein the MCCS performs at least two different unit operations.

31. The process of claim 30, wherein the use of the MCCS involves column switching.

32. The process of claim 29, wherein all of the columns in the MCCS contain gamma-irradiated chromatography resin.

33. The process of claim 29, wherein the MCCS performs the unit operations of capturing the recombinant protein and inactivating viruses.

34. The process of claim 29, wherein the MCCS performs the unit operations of capturing and purifying the recombinant protein.

35. The process of claim 29, wherein the MCCS is a periodic counter current chromatography system.

36. The process of claim 29, wherein the MCCS includes a plurality of columns for affinity chromatography, cation exchange chromatography, anion exchange chromatography, size exclusion chromatography, or hydrophobic interaction chromatography, or any combination thereof.

37. The process of claim 36, wherein the MCCS includes a column for affinity chromatography, and the affinity chromatography is performed with a capture mechanism selected from the group consisting of: protein A-binding capture mechanism, substrate-binding capture mechanism, antibody- or antibody fragment-binding capture mechanism, aptamer-binding capture mechanism, and cofactor-binding capture mechanism.

38. The process of claim 37, wherein the affinity chromatography is performed with a protein-A binding capture mechanism, and the recombinant protein is an antibody or an antibody fragment.

39. The process of claim 29, wherein the recombinant protein is a therapeutic recombinant protein.

40. The process of claim 39, further comprising formulating the purified recombinant protein into a pharmaceutical composition.

41. The process of claim 29, wherein the denaturing buffer comprises one or more of urea, guanidine hydrochloride, and Triton™ X-100.

42. The method of claim 29, wherein the chromatography resin is exposed to wash buffer comprising about 0.5 M to about 1.5 M sodium hydroxide following exposure to denaturing buffer in each cycle.

43. An integrated, closed, and continuous process for manufacturing of a recombinant protein comprising:

(a) providing a liquid culture medium comprising a recombinant protein that is substantially free of cells;

(b) continuously feeding the liquid culture medium into a first multi-column chromatography system (MCCS1);

(c) capturing the recombinant protein from the liquid culture medium using the MCCS1;

(d) producing an eluate from the MCCS1 that comprises the recombinant protein and continuously feeding the eluate into a second multi-column chromatography system (MCCS2);

(e) continuously feeding the recombinant protein from the eluate into the MCCS2 and subsequently eluting the recombinant protein to thereby produce the purified recombinant protein, wherein:

the process utilizes reduced bioburden buffer, is integrated, and runs continuously from the liquid culture medium to the purified recombinant protein, and

at least one column in the MCCS1 and/or MCCS2 is a chromatography column containing gamma-irradiated chromatography resin and the chromatography resin is exposed to denaturing buffer during each cycle in the process.

44. The process of claim 43, wherein the MCCS1 and/or the MCCS2 performs at least two different unit operations.

45. The process of claim 43, wherein the use of the MCCS1 or the MCCS2, or both, involves column switching.

46. The process of claim 43, wherein the MCCS1 further performs the unit operations of capturing the recombinant protein and inactivating viruses.

47. The process of claim 43, wherein the MCCS2 performs the unit operations of purifying and polishing the recombinant protein.

48. The process of claim 43, wherein the MCCS1 and/or MCCS2 utilizes at least two chromatography columns.

49. The process of claim 43, wherein all of the chromatography column(s) in MCCS1 and MCCS2 are chromatography columns containing gamma-irradiated chromatography resin.

50. The process of claim 43, wherein the MCCS1 is a first periodic counter current chromatography system (PCCS1).

51. The process of claim 43, wherein the capturing is performed using affinity chromatography, cation exchange chromatography, anion exchange chromatography, or size exclusion chromatography, hydrophobic interaction chromatography, or any combination thereof.

52. The process of claim 51, wherein capturing is performed using affinity chromatography with a capture mechanism selected from the group consisting of: protein A-binding capture mechanism, substrate-binding capture mechanism, antibody- or antibody fragment-binding capture mechanism, aptamer-binding capture mechanism, and cofactor-binding capture mechanism.

53. The process of claim 52, wherein the affinity chromatography is performed with a protein A-binding capture mechanism, and the recombinant protein is an antibody or an antibody fragment.

54. The process of claim 43, wherein the MCCS2 is a second periodic counter current (PCCS2) chromatography system.

55. The process of claim 43, wherein the recombinant protein is a therapeutic recombinant protein.

56. The process of claim 55, further comprising formulating the purified recombinant protein into a pharmaceutical composition.

57. The process of claim 29 or 43, wherein the process is performed continuously for a period of at least 4 days.

58. The process of claim 57, wherein the process is performed continuously for a period of at least 5 days.

59. The process of claim 58, wherein the process is performed continuously for a period of at least 7 days.

60. The process of claim 59, wherein the process is performed continuously for a period of at least 14 days.

61. The process of claim 59, wherein the process is performed continuously for a period of at least 28 days.

62. The process of claim 29 or 43, wherein the chromatography resin is anionic exchange chromatography resin, cationic exchange chromatography resin, size exclusion chromatography resin, hydrophobic interaction chromatography resin, affinity chromatography resin, or any combination thereof.

63. The process of claim 62, wherein the chromatography resin is anionic exchange chromatography resin.

64. The process of claim 29 or 43, wherein the chromatography resin has been treated with a dose of gamma-irradiation between about 10 kGy to about 40 kGy.

65. The process of claim 64, wherein the chromatography resin has been treated with a dose of gamma-irradiation between about 15 kGy to about 35 kGy.

66. The process of claim 65, wherein the chromatography resin has been treated with a dose of gamma-irradiation between about 20 kGy to about 30 kGy.

67. The process of claim 43, wherein the denaturing buffer comprises one or more of urea, guanidine hydrochloride, and Triton™ X-100.

68. The method of claim 43, wherein the chromatography resin is exposed to a wash buffer comprising about 0.5 M to about 1.5 M sodium hydroxide following exposure to the denaturing buffer.