WHAT IS CLAIMED:

1. A composition including:

a nanopore including a first side, a second side, and an aperture extending through the first and second sides; and

a permanent tether including a head region, a tail region, and an elongated body disposed therebetween,

the head region being anchored to or adjacent to the first side or second side of the nanopore;

a polymerase disposed on the first side, the head region being anchored to the polymerase;

a first nucleotide and first and second polynucleotides each in contact with the polymerase, the polymerase configured to add the first nucleotide to the first polynucleotide based on a sequence of the second polynucleotide; and

the elongated body including a reporter region being movable within the aperture responsive to a first event occurring adjacent to the first side of the nanopore, wherein said first event includes adding the first nucleotide to the first polynucleotide.

2. The composition of claim 1, wherein the reporter region is translationally movable within the aperture responsive to the first event.

3. The composition of any one of claims 1-2, wherein the tail region extends freely toward the second side of the nanopore.

4. The composition of any one of claims 1-3, wherein the reporter region is translationally movable toward the first side of the nanopore responsive to the first event.

5. The composition of any one of claims 1-4, wherein the reporter region is translationally movable toward the second side after the first event.

6. The composition of claim 4, wherein the reporter region further is translationally movable toward the first side responsive to a second event occurring adjacent to the first side of the nanopore, the second event being after the first event.

7. The composition of claim 6, wherein the reporter region further is translationally movable toward the second side after the second event.

8. The composition of any one of claims 6-7, wherein the second event includes adding a second nucleotide to the polynucleotide.

9. The composition of any one of claims 1-8, wherein an electrical or flux blockade characteristic of the reporter region is different than an electrical or flux blockade characteristic of another region of the elongated body.

10. A system including the composition of any one of claims 1-9 and measurement circuitry configured to measure a first current or flux through the aperture or a first optical signal while the reporter region is moved responsive to the first event.

11. The composition of any one of claims 1-9, wherein a first conformational change occurs responsive to the polymerase acting upon a first nucleotide.

12. The composition of claim 11, wherein the first conformational change moves the head region, and the movement of the head region translationally moves the reporter region.

13. The composition of claim 12, wherein the first nucleotide is identifiable based on a measured magnitude or time duration, or both, of a change in a current or flux through the aperture or an optical signal responsive to the translational movement of the reporter region.

14. The composition of any one of claims 11-13, wherein the reporter region further is translationally movable responsive to a second conformational change of the polymerase occurring responsive to the polymerase acting upon a second nucleotide.

15. The composition of claim 14, wherein the first nucleotide is identifiable based on a measured magnitude or time duration, or both, of a first change in a current or flux through the aperture or a first optical signal responsive to the translational movement of the reporter region responsive to the first conformational change.

16. The composition of claim 15, wherein the second nucleotide is identifiable based on a measured magnitude or time duration, or both, of a second change in the current or flux through the aperture or a second optical signal responsive to the translational movement of the reporter region responsive to the second conformational change.

17. The composition of claim 16, wherein the first and second nucleotides are individually distinguishable from one another based on the first and second changes in the current or flux or based on the first and second optical signals.

18. The composition of any one of claims 1-9, wherein the first nucleotide includes an elongated tag including a moiety that interacts with the tether.

19. The composition of claim 18, wherein the interaction of the moiety with the tether translationally moves the reporter region.

20. The composition of any one of claims 18-19, wherein the elongated body of the tether includes a synthetic polymer.

21. The composition of any one of claims 18-19, wherein the tether includes a first oligonucleotide.

22. The composition of claim 21, wherein an abasic nucleotide of the first oligonucleotide defines the reporter region.

23. The composition of claim 22, wherein the moiety includes a second oligonucleotide that hybridizes to the first oligonucleotide.

24. The composition of claim 23, wherein the hybridization of the second oligonucleotide to the first oligonucleotide shortens the tether by a first amount.

25. The composition of claim 24, wherein the first nucleotide is identifiable based on a measured magnitude or time duration, or both, of change in a current or flux through the aperture or an optical signal responsive to the shortening of the tether by the first amount.

26. The composition of claim 25, wherein the reporter region further is translationally movable toward the first side responsive to the polymerase acting upon a second nucleotide.

27. The composition of claim 26, wherein the second nucleotide includes a third oligonucleotide that hybridizes to the first oligonucleotide.

28. The composition of claim 27, wherein the hybridization of the third oligonucleotide to the first oligonucleotide shortens the tether by a second amount.

29. The composition of claim 28, wherein the first nucleotide is identifiable based on a measured magnitude or time duration, or both, of a first change in a current or flux through the aperture or a first optical signal responsive to the shortening of the tether by the first amount.

30. The composition of claim 29, wherein the second nucleotide is identifiable based on a measured magnitude or time duration, or both, of a second change in the current or flux through the aperture or a second optical signal responsive to the shortening of the tether by the second amount.

31. The composition of claim 30, wherein the first and second nucleotides are individually distinguishable from one another based on the first and second changes in the current or flux or based on the first and second optical signals.

32. A method including:

providing a nanopore including a first side, a second side, and an aperture extending through the first and second sides;

disposing a polymerase on the first side

providing a permanent tether including a head region, a tail region, and an elongated body disposed therebetween,

the head region being anchored to or adjacent to the first or second side of the nanopore and being anchored to the polymerase,

the elongated body including a reporter region;

contacting the polymerase with a first nucleotide and with first and second polynucleotides, the polymerase adding the first nucleotide to the first polynucleotide based on a sequence of the second polynucleotide; and

moving the reporter within the aperture responsive to a first event occurring adjacent to the first side of the nanopore; wherein said first event includes adding the first nucleotide to the first polynucleotide.

33. The method of claim 32, wherein the reporter region is translationally moved within the aperture responsive to the first event.

34. The method of any one of claims 32-33, wherein the tail region extends freely toward the second side of the nanopore.

35. The method of any one of claims 32-34, wherein the reporter region is translationally moved toward the first side of the nanopore responsive to the first event.

36. The method of any one of claims 32-35, further including translationally moving the reporter region toward the second side after the first event.

37. The method of claim 35, further including translationally moving the reporter region toward the first side responsive to a second event occurring adjacent to the first side of the nanopore, the second event being after the first event.

38. The method of claim 37, further including translationally moving the reporter region toward the second side after the second event.

39. The method of any one of claims 37-38, wherein the second event includes adding a second nucleotide to the polynucleotide.

40. The method of any one of claims 32-39, wherein an electrical or flux blockade characteristic of the reporter region is different than an electrical or flux blockade characteristic of another region of the elongated body.

41. The method of any one of claims 32-40, further including measuring a first current or flux through the aperture or a first optical signal while the reporter region is moved responsive to the first event.

42. The method of any one of claims 32-41, wherein a first conformational change moves the head region, and the movement of the head region translationally moves the reporter region.

43. The method of any one of claims 32-42, wherein the first conformational change occurs responsive to the polymerase acting upon a first nucleotide.

44. The method of any one of claims 32-43, wherein the first conformational change moves the head region, and the movement of the head region translationally moves the reporter region.

45. The method of claim 44, further including identifying the first nucleotide based on a measured magnitude or time duration, or both, of a change in a current or flux through the aperture or an optical signal responsive to the translational movement of the reporter region.

46. The method of any one of claims 43-45, further including translationally moving the reporter region responsive to a second conformational change of the polymerase occurring responsive to the polymerase acting upon a second nucleotide.

47. The method of claim 46, further including identifying the first nucleotide based on a measured magnitude or time duration, or both, of a first change in a current or flux through the aperture or a first optical signal responsive to the translational movement of the reporter region responsive to the first conformational change.

48. The method of claim 47, further including identifying the second nucleotide based on a measured magnitude or time duration, or both, of a second change in the current or flux through the aperture or a second optical signal responsive to the translational movement of the reporter region responsive to the second conformational change.

49. The method of claim 48, wherein the first and second nucleotides are individually distinguishable from one another based on the first and second changes in the current or flux or based on the first and second optical signals.

50. The method of any one of claims 32-49, wherein the first nucleotide includes an elongated tag including a moiety that interacts with the tether.

51. The method of claim 50, wherein the interaction of the moiety with the tether translationally moves the reporter region.

52. The method of any one of claims 32-51, wherein the elongated body of the tether includes a synthetic polymer.

53. The method of any one of claims 32-51, wherein the tether includes a first oligonucleotide.

54. The method of claim 53, wherein an abasic nucleotide of the first oligonucleotide defines the reporter region.

55. The method of claim 53 or claim 54, wherein the moiety includes a second oligonucleotide that hybridizes to the first oligonucleotide.

56. The method of claim 55, wherein the hybridization of the second oligonucleotide to the first oligonucleotide shortens the tether by a first amount.

57. The method of claim 56, further including identifying the first nucleotide based on a measured magnitude or time duration, or both, of a change in a current or flux through the aperture or an optical signal responsive to the shortening of the tether by the first amount.

58. The method of claim 57, further including translationally moving the reporter region toward the first side responsive to the polymerase acting upon a second nucleotide.

59. The method of claim 58, wherein the second nucleotide includes a third oligonucleotide that hybridizes to the first oligonucleotide.

60. The method of claim 59, wherein the hybridization of the third oligonucleotide to the first oligonucleotide shortens the tether by a second amount.

61. The method of claim 60, further including identifying the first nucleotide based on a measured magnitude or time duration, or both, of a first change in a current or flux through the aperture or a first optical signal responsive to the shortening of the tether by the first amount.

62. The method of claim 61, further including identifying the second oligonucleotide based on a measured magnitude or time duration, or both, of a second change in the current or flux through the aperture or a second optical signal responsive to the shortening of the tether by the second amount.

63. The method of claim 62, wherein the first and second nucleotides are individually distinguishable from one another based on the first and second changes in the current or flux or based on the first and second optical signals.

64. The method of any one of claims 32-63, wherein the head region is anchored to the first side of the nanopore.

65. The method of any one of claims 32-64, wherein the polymerase is in contact with the first side of the nanopore.

66. The method of any one of claims 32-65, wherein the polymerase is anchored to or adjacent to the first side of the nanopore.

67. The composition of claim 1, the polymerase being modified so as to delay release of pyrophosphate responsive to addition of the first nucleotide to the first polynucleotide.

68. The composition of claim 67, wherein the polymerase comprises a modified recombinant Φ29, B103, GA-1, PZA, Φ15, BS32, M2Y, Nf, G1, Cp-1, PRD1, PZE, SF5, Cp-5, Cp-7, PR4, PR5, PR722, or L17 polymerase.

69. The composition of claim 68, wherein the polymerase comprises a modified recombinant Φ29 DNA polymerase having at least one amino acid substitution or combination of substitutions selected from the group consisting of: an amino acid substitution at position 484, an amino acid substitution at position 198, and an amino acid substitution at position 381.

70. The composition of claim 68, wherein the polymerase comprises a modified recombinant Φ29 DNA polymerase having at least one amino acid substitution or combination of substitutions selected from the group consisting of E375Y, K512Y, T368F, A484E, A484Y, N387L, T372Q, T372L, K478Y, I370W, F198W, and L381A.

71. The method of claim 32, the polymerase being modified so as to delay release of pyrophosphate responsive to addition of the first nucleotide to the first polynucleotide.

72. The method of claim 71, wherein the polymerase comprises a modified recombinant Φ29, B103, GA-1, PZA, Φ15, BS32, M2Y, Nf, G1, Cp-1, PRD1, PZE, SF5, Cp-5, Cp-7, PR4, PR5, PR722, or L17 polymerase.

73. The method of claim 71, wherein the polymerase comprises a modified recombinant Φ29 DNA polymerase having at least one amino acid substitution or combination of substitutions selected from the group consisting of: an amino acid substitution at position 484, an amino acid substitution at position 198, and an amino acid substitution at position 381.

74. The method of claim 71, wherein the polymerase comprises a modified recombinant Φ29 DNA polymerase having at least one amino acid substitution or combination of substitutions selected from the group consisting of E375Y, K512Y, T368F, A484E, A484Y, N387L, T372Q, T372L, K478Y, I370W, F198W, and L381A.

75. The composition of claim 1, the first nucleotide being coupled to a reversible terminator that inhibits the polymerase from adding a second nucleotide to the first polynucleotide.

76. The composition of claim 75, wherein the reversible terminator is cleavable by exposure to light or heat.

77. The composition of claim 76, wherein the reversible terminator is cleavable by absorption of heat from the light.

78. The composition of claim 76, wherein the reversible terminator is cleavable by a photochemical reaction induced by the light.

79. The composition of claim 75, wherein the reversible terminator is cleavable by reaction with a chemical agent.

80. The composition of claim 79, further comprising a source of the chemical agent.

81. The composition of claim 80, wherein the reversible terminator is disposed on the first side, wherein the source of the chemical agent is disposed on the second side such that the chemical agent moves from the second side to the first side through the aperture.

82. The composition of claim 79, wherein the reversible terminator comprises azidomethyl (CH_2N_3), and wherein the chemical agent comprises THP.

83. An apparatus comprising the composition of claim 1, wherein the composition is present in a flow cell and the flow cell is configured to replenish reagents that are in contact with the polymerase.

84. The method of claim 32, further contacting the polymerase with a first nucleotide and with first and second polynucleotides, the polymerase adding the first nucleotide to the first polynucleotide based on a sequence of the second polynucleotide.

85. The method of claim 84, the first nucleotide being coupled to a reversible terminator, the method further including inhibiting, by the reversible terminator, the polymerase from adding a second nucleotide to the first polynucleotide.

86. The method of claim 85, the method further comprising cleaving the reversible terminator by exposure to light or heat.

87. The method of claim 86, comprising cleaving the reversible terminator by absorption of heat from the light.

88. The method of claim 86, comprising cleaving the reversible terminator by a photochemical reaction induced by the light.

89. The method of claim 85, the method further comprising cleaving the reversible terminator by reaction with a chemical agent.

90. The method of claim 89, further comprising providing a source of the chemical agent.

91. The method of claim 90, further comprising flowing fluid past the polymerase to remove the chemical agent.

92. The method of claim 91, further comprising supplying new reagents to the polymerase by fluid flow.

93. The method of claim 92, wherein the reversible terminator is disposed on the first side and wherein the source of the chemical agent is disposed on the second side, the method comprising moving the chemical agent from the second side to the first side through the aperture.

94. The method of claim 89, wherein the reversible terminator comprises azidomethyl (CH_2N_3), and wherein the chemical agent comprises THP.