the nanopore) are detected as the nucleotide traverses through the nanopore. Based on the detected changes in the electrical current, the nucleotide may be identified and sequenced.

[0004] Areas for improving and broadening the scope of conventional systems and techniques of nucleic acid detection have been identified, and technical solutions have been implemented in exemplary embodiments.

SUMMARY

[0005] In one embodiment, a method is provided for detecting the presence or absence of an analyte in a sample. The method includes introducing a sample into a channel, the channel having a length and a width, the length substantially greater than the width; measuring an electrical property value of an electrical property along at least a portion of the length of the channel after the sample is introduced into the channel; accessing a reference electrical property value, the reference electrical property value associated with the electrical property of the channel along at least a portion of the length of the channel prior to introduction of the sample into the channel; comparing the measured electrical property value and the reference electrical property value; and determining whether an analyte is present in the channel based on the comparison between the measured electrical property value and the reference electrical property value.

[0006] In another embodiment, a method is provided for detecting the presence or absence of an analyte in a sample. The method includes measuring one or more electrical properties of a channel along at least a portion of the length of the channel, the channel having a length and a width, the length substantially greater than the width; determining a reference channel electrical property value based on the one or more electrical properties of the channel measured during the previous measuring step; introducing a sample into the channel; measuring the one or more electrical properties of the channel along the same portion of the length of the channel that was measured in the first measuring step with the sample in the channel; determining a sample channel electrical property value based on the one or more electrical properties of the channel measured with the sample in the channel; determining any differences between the sample channel electrical property value and the reference channel electrical property value; and determining whether an analyte is present in

the channel based on the differences, if any, between the sample channel electrical property value and the reference channel electrical property value.

[0007] In another embodiment, a method is provided for detecting the presence or absence of an analyte in a sample. The method includes introducing a sample and a sensor compound into a channel, the channel having a length and a width, the length substantially greater than the width; measuring an electrical property value along at least a portion of the length of the channel after the sample and the sensor compound are introduced into the channel; accessing a reference electrical property value from memory, the reference electrical property value associated with at least a portion of the length of the channel; determining any differences between the measured electrical property value and the reference electrical property value; and determining whether an analyte is present in the channel based on the differences, if any, between the measured electrical property value and the reference electrical property value.

[0008] In another embodiment, a method is provided for detecting the presence or absence of an analyte in a sample. The method includes introducing a sensor compound into a channel, the channel having a length and a width, the length being substantially greater than the width; measuring one or more electrical properties of the channel along at least a portion of the length of the channel; determining a reference channel electrical property value based on the one or more electrical properties of the channel measured during the previous measuring step; introducing a sample into the channel; measuring the one or more electrical properties of the channel along at least the portion of the length of the channel after the sample and the sensor compound are introduced into the channel; determining an electrical property value based on the one or more electrical properties measured after the sensor compound and the sample are introduced into the channel; determining any differences between the reference channel electrical property value and the electrical property value; and determining whether an analyte is present in the channel based on the differences, if any, between the reference channel electrical property value and the electrical property value.

[0009] In another embodiment, a method is provided for detecting the presence or absence of an analyte in a sample. The method includes introducing a sensor compound into a channel, the channel having a length and a width, the length being substantially greater than

the width; introducing a sample into the channel; measuring one or more electrical properties of the channel along at least a portion of the length of the channel after the sample and the sensor compound are introduced into the channel; determining an electrical property value based on the one or more electrical properties measured after the sensor compound and the sample are introduced into the channel; accessing a reference channel electrical property value, the reference channel electrical property value measured prior to introduction of both the sensor compound and the sample into the channel; determining any differences between the reference channel electrical property value and the electrical property value; and determining whether an analyte is present in the channel based on the differences, if any, between the reference channel electrical property value and the electrical property value.

[0010] In another embodiment, a method is provided for detecting the presence or absence of an analyte in a sample. The method includes introducing a sample into a channel, the channel having a length and a width, the length being substantially greater than the width; measuring one or more electrical properties of the channel along at least a portion of the length of the channel; determining a reference channel electrical property value based on the one or more electrical properties of the channel measured during the previous measuring step; introducing a sensor compound into the channel; measuring the one or more electrical properties of the channel along at least the portion of the length of the channel after the sample and the sensor compound are introduced into the channel; determining an electrical property value based on the one or more electrical properties measured after the sensor compound and the sample are introduced into the channel; determining any differences between the reference channel electrical property value and the electrical property value; and determining whether an analyte is present in the channel based on the differences, if any, between the reference channel electrical property value and the electrical property value.

[0011] In another embodiment, a method is provided for detecting the presence or absence of an analyte in a sample. The method includes introducing a sample into a channel, the channel having a length and a width, the length being substantially greater than the width; introducing a sensor compound into the channel; measuring one or more electrical properties of the channel along at least a portion of the length of the channel after the sample and the sensor compound are introduced into the channel; determining an electrical property value

based on the one or more electrical properties measured after the sensor compound and the sample are introduced into the channel; accessing a reference channel electrical property value, the reference channel electrical property value measured prior to introduction of both the sensor compound and the sample into the channel; determining any differences between the reference channel electrical property value and the electrical property value; and determining whether an analyte is present in the channel based on the differences, if any, between the reference channel electrical property value and the electrical property value.

[0012] In another embodiment, a method is provided for detecting the presence or absence of an analyte in a sample. The method includes coating at least a portion of an inner surface of a channel with a sensor compound, the channel having a length and a width, the length substantially greater than the width; measuring one or more electrical properties of the channel along at least a portion of the length of the channel after the channel is coated with the sensor compound; determining a reference channel electrical property value based on the one or more electrical properties of the channel measured during the previous measuring step; and storing the reference channel electrical property value for use in determining whether or not an analyte is present in a sample introduced in the channel.

[0013] In another embodiment, a method is provided for detecting the presence or absence of an analyte in a sample. The method includes introducing a sample and a sensor compound into a channel, the channel having a length and a width, the length substantially greater than the width. The method also includes applying a first potential difference across the length of the channel in a first direction along the length of the channel. The method also includes measuring a first electrical property value of an electrical property along at least a portion of the length of the channel while the first potential difference is applied. The method also includes applying a second potential difference across the length of the channel in a second direction along the length of the channel, the second direction opposite to the first direction. The method also includes measuring a second electrical property value of the electrical property along at least the portion of the length of the channel while the second potential difference is applied. The method also includes comparing the first and second electrical property values. The method also includes determining whether an analyte is

present in the channel based on the comparison between the first and second electrical property values.

[0014] In one embodiment, a detection system is provided. The detection system includes a substrate, the substrate having at least one channel, the at least one channel having a length and a width, the length substantially greater than the width. The detection system also includes a first port in fluid communication with a first end section of the at least one channel, and a second port in fluid communication with a second end section of the at least one channel. The detection system also includes a first electrode electrically connected at the first end section of the at least one channel and a second electrode electrically connected at the second end section of the at least one channel. The first and second electrodes are electrically connected to their respective first and second end sections of the at least one channel to form a channel circuit. The channel circuit has electrical properties and is configured such that when an electrically conductive fluid is present in the at least one channel, the electrically conductive fluid alters the electrical properties of the channel circuit. The detection system also includes an analyte detection circuit in electrical communication with the first and second electrodes. The analyte detection circuit includes a measurement circuit in electrical communication with the first and second electrode. The measurement circuit has a measurement circuit output, the measurement circuit output including one or more values indicative of one or more electrical properties of the channel circuit. The analyte detection circuit also includes a memory in electrical communication with the measurement circuit output and configured to store the one or more values indicative of the one or more electrical properties of the channel circuit including at least a first value of an electrical property of the channel circuit and a second value of the electrical property of the channel circuit. The analyte detection circuit further includes a comparison circuit in electrical communication with the memory and having as inputs the at least first and second values. The comparison circuit is configured to provide a comparison circuit output based at least in part on the at least first and/or second values. The comparison circuit output is indicative of whether an analyte is present in the at least one channel.

[0015] In another embodiment, a detection system is provided. The detection system includes a substrate, the substrate having at least one channel, the at least one channel

having a length and a width, the length substantially greater than the width. The detection system also includes a first port in fluid communication with a first end section of the at least one channel, and a second port in fluid communication with a second end section of the at least one channel. The detection system also includes a first electrode electrically connected at the first end section of the at least one channel and a second electrode electrically connected at the second end section of the at least one channel. The first and second electrodes are electrically connected to their respective first and second end sections of the at least one channel such that when an electrically conductive fluid is present in the at least one channel, the electrically conductive fluid completes an electrical circuit between the first and second electrodes. The detection system also includes analyte detection circuitry in electrical communication with the first and second electrodes. The analyte detection circuitry is configured to measure one or more electrical properties between the first and second electrodes. The analyte detection circuitry includes a memory, the memory configured to store a measured electrical property value. The analyte detection circuitry further includes a comparison circuit configured to detect presence of an analyte in the at least one channel based on the measured electrical property value.

[0016] In another embodiment, a detection system is provided. The detection system includes means for accommodating a fluid flow, means for introducing a fluid at a first terminal end of the means for accommodating the fluid flow, means for outputting the fluid at a second terminal end of the means for accommodating the fluid flow, means for detecting first and second values of an electrical property of the fluid between the first and second terminal ends of the means for accommodating the fluid flow, and means for determining whether an analyte is present in the fluid based on a difference between the first and second values of the electrical property.

[0017] In one embodiment, a method is provided for detecting the presence or absence of mercury ions in a sample. The method includes introducing a sample into a channel, the channel having a length and a width, the length substantially greater than the width; measuring an electrical property value of an electrical property along at least a portion of the length of the channel after the sample is introduced into the channel; accessing a reference electrical property value, the reference electrical property value associated with the

electrical property of the channel along at least a portion of the length of the channel prior to introduction of the sample into the channel; comparing the measured electrical property value and the reference electrical property value; and determining whether mercury ions are present in the channel based on the comparison between the measured electrical property value and the reference electrical property value.

[0018] In another embodiment, a method is provided for detecting the presence or absence of mercury ions in a sample. The method includes measuring one or more electrical properties of a channel along at least a portion of the length of the channel, the channel having a length and a width, the length substantially greater than the width; determining a reference channel electrical property value based on the one or more electrical properties of the channel measured during the previous measuring step; introducing a sample into the channel; measuring the one or more electrical properties of the channel along the same portion of the length of the channel that was measured in the first measuring step with the sample in the channel; determining a sample channel electrical property value based on the one or more electrical properties of the channel measured with the sample in the channel; determining any differences between the sample channel electrical property value and the reference channel electrical property value; and determining whether mercury ions are present in the channel based on the differences, if any, between the sample channel electrical property value and the reference channel electrical property value.

[0019] In another embodiment, a method is provided for detecting the presence or absence of mercury ions in a sample. The method includes introducing a sample and TPET2 molecules into a channel, the channel having a length and a width, the length substantially greater than the width; measuring an electrical property value along at least a portion of the length of the channel after the sample and the TPET2 molecules are introduced into the channel; accessing a reference electrical property value from memory, the reference electrical property value associated with at least a portion of the length of the channel; determining any differences between the measured electrical property value and the reference electrical property value; and determining whether mercury ions are present in the channel based on the differences, if any, between the measured electrical property value and the reference electrical property value.

[0020] In another embodiment, a method is provided for detecting the presence or absence of mercury ions in a sample. The method includes introducing TPET2 molecules into a channel, the channel having a length and a width, the length being substantially greater than the width; measuring one or more electrical properties of the channel along at least a portion of the length of the channel; determining a reference channel electrical property value based on the one or more electrical properties of the channel measured during the previous measuring step; introducing a sample into the channel; measuring the one or more electrical properties of the channel along at least the portion of the length of the channel after the sample and the TPET2 molecules are introduced into the channel; determining an electrical property value based on the one or more electrical properties measured after the TPET2 molecules and the sample are introduced into the channel; determining any differences between the reference channel electrical property value and the electrical property value; and determining whether mercury ions are present in the channel based on the differences, if any, between the reference channel electrical property value and the electrical property value.

[0021] In another embodiment, a method is provided for detecting the presence or absence of mercury ions in a sample. The method includes introducing TPET2 molecules into a channel, the channel having a length and a width, the length being substantially greater than the width; introducing a sample into the channel; measuring one or more electrical properties of the channel along at least a portion of the length of the channel after the sample and the TPET2 molecules are introduced into the channel; determining an electrical property value based on the one or more electrical properties measured after the TPET2 molecules and the sample are introduced into the channel; accessing a reference channel electrical property value, the reference channel electrical property value measured prior to introduction of both the TPET2 molecules and the sample into the channel; determining any differences between the reference channel electrical property value and the electrical property value; and determining whether mercury ions are present in the channel based on the differences, if any, between the reference channel electrical property value and the electrical property value.

[0022] In another embodiment, a method is provided for detecting the presence or absence of mercury ions in a sample. The method includes introducing a sample into the channel, the channel having a length and a width, the length being substantially greater than

the width; measuring one or more electrical properties of the channel along at least a portion of the length of the channel; determining a reference channel electrical property value based on the one or more electrical properties of the channel measured during the previous measuring step; introducing TPET2 molecules into a channel; measuring the one or more electrical properties of the channel along at least the portion of the length of the channel after the sample and the TPET2 molecules are introduced into the channel; determining an electrical property value based on the one or more electrical properties measured after the TPET2 molecules and the sample are introduced into the channel; determining any differences between the reference channel electrical property value and the electrical property value; and determining whether mercury ions are present in the channel based on the differences, if any, between the reference channel electrical property value and the electrical property value.

[0023] In another embodiment, a method is provided for detecting the presence or absence of mercury ions in a sample. The method includes introducing a sample into the channel, the channel having a length and a width, the length being substantially greater than the width; introducing TPET2 molecules into a channel; measuring one or more electrical properties of the channel along at least a portion of the length of the channel after the sample and the TPET2 molecules are introduced into the channel; determining an electrical property value based on the one or more electrical properties measured after the TPET2 molecules and the sample are introduced into the channel; accessing a reference channel electrical property value, the reference channel electrical property value measured prior to introduction of both the TPET2 molecules and the sample into the channel; determining any differences between the reference channel electrical property value and the electrical property value; and determining whether mercury ions are present in the channel based on the differences, if any, between the reference channel electrical property value and the electrical property value.

[0024] In another embodiment, a method is provided for detecting the presence or absence of mercury ions in a sample. The method includes coating at least a portion of an inner surface of a channel with TPET2 molecules, the channel having a length and a width, the length substantially greater than the width; measuring one or more electrical properties of the channel along at least a portion of the length of the channel after the channel is coated

with the TPET2 molecules; determining a reference channel electrical property value based on the one or more electrical properties of the channel measured during the previous measuring step; and storing the reference channel electrical property value for use in determining whether or not mercury ions are present in a sample introduced in the channel.

[0025] In another embodiment, a method is provided for detecting the presence or absence of mercury ions in a sample. The method includes introducing a sample and TPET2 molecules into a channel, the channel having a length and a width, the length substantially greater than the width. The method also includes applying a first potential difference across the length of the channel in a first direction along the length of the channel. The method also includes measuring a first electrical property value of an electrical property along at least a portion of the length of the channel while the first potential difference is applied. The method also includes applying a second potential difference across the length of the channel in a second direction along the length of the channel, the second direction opposite to the first direction. The method also includes measuring a second electrical property value of the electrical property along at least the portion of the length of the channel while the second potential difference is applied. The method also includes comparing the first and second electrical property values. The method also includes determining whether mercury ions are present in the channel based on the comparison between the first and second electrical property values.

[0026] In another embodiment, a mercury detection system is provided. The system includes a substrate, the substrate having at least one channel, the at least one channel having a length and a width, the length substantially greater than the width; a first port in fluid communication with a first end section of the at least one channel; and a second port in fluid communication with a second end section of the at least one channel. The system also includes a first electrode electrically connected at the first end section of the at least one channel and a second electrode electrically connected at the second end section of the at least one channel, the first and second electrodes electrically connected to their respective first and second end sections of the at least one channel to form a channel circuit, the channel circuit having electrical properties and configured such that when an electrically conductive fluid is present in the at least one channel, the electrically conductive fluid alters the electrical

properties of the channel circuit. The system further includes a mercury detection circuit in electrical communication with the first and second electrodes, the mercury detection circuit including a measurement circuit in electrical communication with the first and second electrode, the measurement circuit having a measurement circuit output, the measurement circuit output including one or more values indicative of one or more electrical properties of the channel circuit, the mercury detection circuit including a memory in electrical communication with the measurement circuit output and configured to store the one or more values indicative of the one or more electrical properties of the channel circuit including at least a first value of an electrical property of the channel circuit and a second value of the electrical property of the channel circuit, the mercury detection circuit further including a comparison circuit in electrical communication with the memory and having as inputs the at least first and second values, the comparison circuit configured to provide a comparison circuit output based at least in part on the at least first and/or second values, the comparison circuit output indicative of whether mercury ions are present in the at least one channel.

[0027] In another embodiment, a mercury detection system is provided. The system includes means for accommodating a fluid flow; means for introducing a fluid at a first terminal end of the means for accommodating the fluid flow; means for outputting the fluid at a second terminal end of the means for accommodating the fluid flow; means for detecting first and second values of an electrical property of the fluid between the first and second terminal ends of the means for accommodating the fluid flow; and means for determining whether mercury ions are present in the fluid based on a difference between the first and second values of the electrical property.

[0028] In one embodiment, a method is provided for detecting the presence or absence of silver ions in a sample. The method includes introducing a sample into a channel, the channel having a length and a width, the length substantially greater than the width; measuring an electrical property value of an electrical property along at least a portion of the length of the channel after the sample is introduced into the channel; accessing a reference electrical property value, the reference electrical property value associated with the electrical property of the channel along at least a portion of the length of the channel prior to introduction of the sample into the channel; comparing the measured electrical property value

and the reference electrical property value; and determining whether silver ions are present in the channel based on the comparison between the measured electrical property value and the reference electrical property value.

[0029] In another embodiment, a method is provided for detecting the presence or absence of silver ions in a sample. The method includes measuring one or more electrical properties of a channel along at least a portion of the length of the channel, the channel having a length and a width, the length substantially greater than the width; determining a reference channel electrical property value based on the one or more electrical properties of the channel measured during the previous measuring step; introducing a sample into the channel; measuring the one or more electrical properties of the channel along the same portion of the length of the channel that was measured in the first measuring step with the sample in the channel; determining a sample channel electrical property value based on the one or more electrical properties of the channel measured with the sample in the channel; determining any differences between the sample channel electrical property value and the reference channel electrical property value; and determining whether silver ions are present in the channel based on the differences, if any, between the sample channel electrical property value and the reference channel electrical property value.

[0030] In another embodiment, a method is provided for detecting the presence or absence of silver ions in a sample. The method includes introducing a sample and TPEA2 molecules into a channel, the channel having a length and a width, the length substantially greater than the width; measuring an electrical property value along at least a portion of the length of the channel after the sample and the TPEA2 molecules are introduced into the channel; accessing a reference electrical property value from memory, the reference electrical property value associated with at least a portion of the length of the channel; determining any differences between the measured electrical property value and the reference electrical property value; and determining whether silver ions are present in the channel based on the differences, if any, between the measured electrical property value and the reference electrical property value.

[0031] In another embodiment, a method is provided for detecting the presence or absence of silver ions in a sample. The method includes introducing TPEA2 molecules into a

channel, the channel having a length and a width, the length being substantially greater than the width; measuring one or more electrical properties of the channel along at least a portion of the length of the channel; determining a reference channel electrical property value based on the one or more electrical properties of the channel measured during the previous measuring step; introducing a sample into the channel; measuring the one or more electrical properties of the channel along at least the portion of the length of the channel after the sample and the TPEA2 molecules are introduced into the channel; determining an electrical property value based on the one or more electrical properties measured after the TPEA2 molecules and the sample are introduced into the channel; determining any differences between the reference channel electrical property value and the electrical property value; and determining whether silver ions are present in the channel based on the differences, if any, between the reference channel electrical property value and the electrical property value.

[0032] In another embodiment, a method is provided for detecting the presence or absence of silver ions in a sample. The method includes introducing TPEA2 molecules into a channel, the channel having a length and a width, the length being substantially greater than the width; introducing a sample into the channel; measuring one or more electrical properties of the channel along at least a portion of the length of the channel after the sample and the TPEA2 molecules are introduced into the channel; determining an electrical property value based on the one or more electrical properties measured after the TPEA2 molecules and the sample are introduced into the channel; accessing a reference channel electrical property value, the reference channel electrical property value measured prior to introduction of both the TPEA2 molecules and the sample into the channel; determining any differences between the reference channel electrical property value and the electrical property value; and determining whether silver ions are present in the channel based on the differences, if any, between the reference channel electrical property value and the electrical property value.

[0033] In another embodiment, a method is provided for detecting the presence or absence of silver ions in a sample. The method includes introducing a sample into the channel, the channel having a length and a width, the length being substantially greater than the width; measuring one or more electrical properties of the channel along at least a portion of the length of the channel; determining a reference channel electrical property value based

on the one or more electrical properties of the channel measured during the previous measuring step; introducing TPEA2 molecules into a channel; measuring the one or more electrical properties of the channel along at least the portion of the length of the channel after the sample and the TPEA2 molecules are introduced into the channel; determining an electrical property value based on the one or more electrical properties measured after the TPEA2 molecules and the sample are introduced into the channel; determining any differences between the reference channel electrical property value and the electrical property value; and determining whether silver ions are present in the channel based on the differences, if any, between the reference channel electrical property value and the electrical property value.

[0034] In another embodiment, a method is provided for detecting the presence or absence of silver ions in a sample. The method includes introducing a sample into the channel, the channel having a length and a width, the length being substantially greater than the width; introducing TPEA2 molecules into a channel; measuring one or more electrical properties of the channel along at least a portion of the length of the channel after the sample and the TPEA2 molecules are introduced into the channel; determining an electrical property value based on the one or more electrical properties measured after the TPEA2 molecules and the sample are introduced into the channel; accessing a reference channel electrical property value, the reference channel electrical property value measured prior to introduction of both the TPEA2 molecules and the sample into the channel; determining any differences between the reference channel electrical property value and the electrical property value; and determining whether silver ions are present in the channel based on the differences, if any, between the reference channel electrical property value and the electrical property value.

[0035] In another embodiment, a method is provided for detecting the presence or absence of silver ions in a sample. The method includes coating at least a portion of an inner surface of a channel with TPEA2 molecules, the channel having a length and a width, the length substantially greater than the width; measuring one or more electrical properties of the channel along at least a portion of the length of the channel after the channel is coated with the TPEA2 molecules; determining a reference channel electrical property value based on the one or more electrical properties of the channel measured during the previous measuring step;

and storing the reference channel electrical property value for use in determining whether or not silver ions are present in a sample introduced in the channel.

[0036] In another embodiment, a method is provided for detecting the presence or absence of silver ions in a sample. The method includes introducing a sample and TPEA2 molecules into a channel, the channel having a length and a width, the length substantially greater than the width. The method also includes applying a first potential difference across the length of the channel in a first direction along the length of the channel. The method also includes measuring a first electrical property value of an electrical property along at least a portion of the length of the channel while the first potential difference is applied. The method also includes applying a second potential difference across the length of the channel in a second direction along the length of the channel, the second direction opposite to the first direction. The method also includes measuring a second electrical property value of the electrical property along at least the portion of the length of the channel while the second potential difference is applied. The method also includes comparing the first and second electrical property values. The method also includes determining whether silver ions are present in the channel based on the comparison between the first and second electrical property values.

[0037] In another embodiment, a silver detection system is provided. The system includes a substrate, the substrate having at least one channel, the at least one channel having a length and a width, the length substantially greater than the width; a first port in fluid communication with a first end section of the at least one channel; and a second port in fluid communication with a second end section of the at least one channel. The system also includes a first electrode electrically connected at the first end section of the at least one channel and a second electrode electrically connected at the second end section of the at least one channel, the first and second electrodes electrically connected to their respective first and second end sections of the at least one channel to form a channel circuit, the channel circuit having electrical properties and configured such that when an electrically conductive fluid is present in the at least one channel, the electrically conductive fluid alters the electrical properties of the channel circuit. The system further includes a silver detection circuit in electrical communication with the first and second electrodes, the silver detection circuit

including a measurement circuit in electrical communication with the first and second electrode, the measurement circuit having a measurement circuit output, the measurement circuit output including one or more values indicative of one or more electrical properties of the channel circuit, the silver detection circuit including a memory in electrical communication with the measurement circuit output and configured to store the one or more values indicative of the one or more electrical properties of the channel circuit including at least a first value of an electrical property of the channel circuit and a second value of the electrical property of the channel circuit, the silver detection circuit further including a comparison circuit in electrical communication with the memory and having as inputs the at least first and second values, the comparison circuit configured to provide a comparison circuit output based at least in part on the at least first and/or second values, the comparison circuit output indicative of whether an silver is present in the at least one channel.

[0038] In another embodiment, a silver detection system is provided. The system includes means for accommodating a fluid flow; means for introducing a fluid at a first terminal end of the means for accommodating the fluid flow; means for outputting the fluid at a second terminal end of the means for accommodating the fluid flow; means for detecting first and second values of an electrical property of the fluid between the first and second terminal ends of the means for accommodating the fluid flow; and means for determining whether silver is present in the fluid based on a difference between the first and second values of the electrical property.

[0038a] Disclosed herein is a method for detecting the presence or absence of a nucleic acid in a sample, the method comprising: introducing the sample into a channel comprising an inner space disposed between a first and a second electrode, the channel having a length and a width, the length substantially greater than the width; measuring an electrical property value of an electrical property along at least a portion of the length of the channel, wherein the measuring is after the sample is introduced into the channel; accessing a reference electrical property value, the reference electrical property value associated with the electrical property of the channel along at least the portion of the length of the channel, wherein the reference electrical property value is obtained prior to introduction of the sample into the channel; comparing the measured electrical property value and the reference electrical property value; and determining whether an aggregate is present in the inner space of the channel based

on the comparison between the measured electrical property value and the reference electrical property value, wherein the aggregate is formed in the channel by an interaction between the nucleic acid and a nucleic acid probe, wherein the nucleic acid probe is allowed to flow along the length of the channel, thereby detecting the presence or absence of the nucleic acid in the sample.

[0038b] Disclosed herein is a method for detecting a nucleic acid in a sample, the method comprising: (a) introducing the sample into a channel comprising an inner space disposed between a first and a second electrode, wherein the channel has a length and a width, the length is substantially greater than the width; (b) measuring an electrical property value of an electrical property along at least a portion of the length of the channel; (c) accessing a reference electrical property value, wherein the reference electrical property value is associated with the electrical property of the channel along at least the portion of the length of the channel, wherein the reference electrical property value is obtained in the absence of the sample in the channel; (d) comparing the measured electrical property value and the reference electrical property value; and (e) detecting an aggregate in the inner space of the channel based on the comparison between the measured electrical property value and the reference electrical property value, wherein the

aggregate is formed in the channel by an interaction between the nucleic acid and a nucleic acid probe, wherein the nucleic acid probe is allowed to flow along the length of the channel, thereby detecting the nucleic acid in the sample.

[0039] In one embodiment, a method is provided for detecting the presence or absence of a nucleic acid in a sample. The method includes introducing a sample into a channel, the channel having a length and a width, the length substantially greater than the width; measuring an electrical property value of an electrical property along at least a portion of the length of the channel after the sample is introduced into the channel; accessing a reference electrical property value, the reference electrical property value associated with the electrical property of the channel along at least a portion of the length of the channel prior to introduction of the sample into the channel; comparing the measured electrical property value and the reference electrical property value; and determining whether the nucleic acid is present in the channel based on the comparison between the measured electrical property value and the reference electrical property value.

[0040] In another embodiment, a method is provided for detecting the presence or absence of a nucleic acid in a sample. The method includes measuring one or more electrical properties of a channel along at least a portion of the length of the channel, the channel having a length and a width, the length substantially greater than the width; determining a reference channel electrical property value based on the one or more electrical properties of the channel measured during the previous measuring step; introducing a sample into the channel; measuring the one or more electrical properties of the channel along the same portion of the length of the channel that was measured in the first measuring step with the sample in the channel; determining a sample channel electrical property value based on the one or more electrical properties of the channel measured with the sample in the channel; determining any differences between the sample channel electrical property value and the reference channel electrical property value; and determining whether a nucleic acid is present in the channel based on the differences, if any, between the sample channel electrical property value and the reference channel electrical property value.

[0041] In another embodiment, a method is provided for detecting the presence or absence of a nucleic acid in a sample. The method includes introducing a sample and one or more nucleic acid probes into a channel, the channel having a length and a width, the length substantially greater than the width; measuring an electrical property value along at least a portion of the length of the channel after the sample and the nucleic acid probes are introduced into the channel; accessing a reference electrical property value from memory, the reference electrical property value associated with at least a portion of the length of the channel; determining any differences between the measured electrical property value and the reference electrical property value; and determining whether the nucleic acid probe is present in the channel based on the differences, if any, between the measured electrical property value and the reference electrical property value.

[0042] In another embodiment, a method is provided for detecting the presence or absence of a nucleic acid probe in a sample. The method includes introducing one or more nucleic acid probes into a channel, the channel having a length and a width, the length being substantially greater than the width; measuring one or more electrical properties of the channel along at least a portion of the length of the channel; determining a reference channel electrical property value based on the one or more electrical properties of the channel measured during the previous measuring step; introducing a sample into the channel; measuring the one or more electrical properties of the channel along at least the portion of the length of the channel after the sample and the one or more nucleic acid probes are introduced into the channel; determining an electrical property value based on the one or more electrical properties measured after the one or more nucleic acid probes and the sample are introduced into the channel; determining any differences between the reference channel electrical property value and the electrical property value; and determining whether the nucleic acid is present in the channel based on the differences, if any, between the reference channel electrical property value and the electrical property value.

[0043] In another embodiment, a method is provided for detecting the presence or absence of a nucleic acid in a sample. The method includes introducing one or more nucleic acid probes into a channel, the channel having a length and a width, the length being substantially greater than the width; introducing a sample into the channel; measuring one or

more electrical properties of the channel along at least a portion of the length of the channel after the sample and the one or more nucleic acid probes are introduced into the channel; determining an electrical property value based on the one or more electrical properties measured after the one or more nucleic acid probes and the sample are introduced into the channel; accessing a reference channel electrical property value, the reference channel electrical property value measured prior to introduction of both the one or more nucleic acid probes and the sample into the channel; determining any differences between the reference channel electrical property value and the electrical property value; and determining whether the nucleic acid is present in the channel based on the differences, if any, between the reference channel electrical property value and the electrical property value.

[0044] In another embodiment, a method is provided for detecting the presence or absence of a nucleic acid in a sample. The method includes introducing a sample into a channel, the channel having a length and a width, the length being substantially greater than the width; measuring one or more electrical properties of the channel along at least a portion of the length of the channel; determining a reference channel electrical property value based on the one or more electrical properties of the channel measured during the previous measuring step; introducing one or more nucleic acid probes into the channel; measuring the one or more electrical properties of the channel along at least the portion of the length of the channel after the sample and the one or more nucleic acid probes are introduced into the channel; determining an electrical property value based on the one or more electrical properties measured after the one or more nucleic acid probes and the sample are introduced into the channel; determining any differences between the reference channel electrical property value and the electrical property value; and determining whether the nucleic acid is present in the channel based on the differences, if any, between the reference channel electrical property value and the electrical property value.

[0045] In another embodiment, a method is provided for detecting the presence or absence of a nucleic acid in a sample. The method includes introducing a sample into a channel, the channel having a length and a width, the length being substantially greater than the width; introducing one or more nucleic acid probes into the channel; measuring one or more electrical properties of the channel along at least a portion of the length of the channel

after the sample and the one or more nucleic acid probes are introduced into the channel; determining an electrical property value based on the one or more electrical properties measured after the one or more nucleic acid probes and the sample are introduced into the channel; accessing a reference channel electrical property value, the reference channel electrical property value measured prior to introduction of both the one or more nucleic acid probes and the sample into the channel; determining any differences between the reference channel electrical property value and the electrical property value; and determining whether the nucleic acid is present in the channel based on the differences, if any, between the reference channel electrical property value and the electrical property value.

[0046] In another embodiment, a method is provided for detecting the presence or absence of a nucleic acid in a sample. The method includes coating at least a portion of an inner surface of a channel with one or more nucleic acid probes, the channel having a length and a width, the length substantially greater than the width; measuring one or more electrical properties of the channel along at least a portion of the length of the channel after the channel is coated with the one or more nucleic acid probes; determining a reference channel electrical property value based on the one or more electrical properties of the channel measured during the previous measuring step; and storing the reference channel electrical property value for use in determining whether or not the nucleic acid is present in a sample introduced in the channel.

[0047] In another embodiment, a method is provided for detecting the presence or absence of a nucleic acid in a sample. The method includes introducing a sample and one or more nucleic acid probes into a channel, the channel having a length and a width, the length substantially greater than the width. The method also includes applying a first potential difference across the length of the channel in a first direction along the length of the channel. The method also includes measuring a first electrical property value of an electrical property along at least a portion of the length of the channel while the first potential difference is applied. The method also includes applying a second potential difference across the length of the channel in a second direction along the length of the channel, the second direction opposite to the first direction. The method also includes measuring a second electrical property value of the electrical property along at least the portion of the length of the channel

while the second potential difference is applied. The method also includes comparing the first and second electrical property values. The method also includes determining whether a nucleic acid is present in the channel based on the comparison between the first and second electrical property values.

[0048] In another embodiment, a nucleic acid detection system is provided. The system includes a substrate, the substrate having at least one channel, the at least one channel having a length and a width, the length substantially greater than the width; a first port in fluid communication with a first end section of the at least one channel; and a second port in fluid communication with a second end section of the at least one channel. The system also includes a first electrode electrically connected at the first end section of the at least one channel and a second electrode electrically connected at the second end section of the at least one channel, the first and second electrodes electrically connected to their respective first and second end sections of the at least one channel to form a channel circuit, the channel circuit having electrical properties and configured such that when an electrically conductive fluid is present in the at least one channel, the electrically conductive fluid alters the electrical properties of the channel circuit. The system further includes a detection circuit in electrical communication with the first and second electrodes, the detection circuit including a measurement circuit in electrical communication with the first and second electrode, the measurement circuit having a measurement circuit output, the measurement circuit output including one or more values indicative of one or more electrical properties of the channel circuit, the detection circuit including a memory in electrical communication with the measurement circuit output and configured to store the one or more values indicative of the one or more electrical properties of the channel circuit including at least a first value of an electrical property of the channel circuit and a second value of the electrical property of the channel circuit, the detection circuit further including a comparison circuit in electrical communication with the memory and having as inputs the at least first and second values, the comparison circuit configured to provide a comparison circuit output based at least in part on the at least first and/or second values, the comparison circuit output indicative of whether a nucleic acid is present in the at least one channel.

[0049] In another embodiment, a nucleic acid detection system is provided. The system includes means for accommodating a fluid flow; means for introducing a fluid at a first terminal end of the means for accommodating the fluid flow; means for outputting the fluid at a second terminal end of the means for accommodating the fluid flow; means for detecting first and second values of an electrical property of the fluid between the first and second terminal ends of the means for accommodating the fluid flow; and means for determining whether a nucleic acid is present in the fluid based on a difference between the first and second values of the electrical property.

BRIEF DESCRIPTION OF THE DRAWINGS

[0050] The foregoing and other objects, aspects, features, and advantages of exemplary embodiments will become more apparent and may be better understood by referring to the following description taken in conjunction with the accompanying drawings.

[0051] Figure 1A illustrates a top view of an exemplary detection system including a single channel.

[0052] Figure 1B illustrates a cross-sectional side view of the exemplary detection system of Figure 1A.

[0053] Figure 2 illustrates a schematic cross-sectional side view of the channel of the exemplary detection system of Figure 1A, showing aggregate particles and an electrical double layer (EDL).

[0054] Figure 3 illustrates a top view of an exemplary detection system including multiple channels.

[0055] Figure 4 illustrates a top view of another exemplary detection system including multiple channels.

[0056] Figure 5 is a schematic representing exemplary ions in an exemplary detection system.

[0057] Figures 6A and 6B are graphs illustrating exemplary conductivity values measured in a channel at different concentrations of an exemplary analyte.

WHAT IS CLAIMED IS:

1. A method for detecting the presence or absence of a nucleic acid in a sample, the method comprising:

introducing the sample into a channel comprising an inner space disposed between a first and a second electrode, the channel having a length and a width, the length substantially greater than the width;

measuring an electrical property value of an electrical property along at least a portion of the length of the channel, wherein the measuring is after the sample is introduced into the channel;

accessing a reference electrical property value, the reference electrical property value associated with the electrical property of the channel along at least the portion of the length of the channel, wherein the reference electrical property value is obtained prior to introduction of the sample into the channel;

comparing the measured electrical property value and the reference electrical property value; and

determining whether an aggregate is present in the inner space of the channel based on the comparison between the measured electrical property value and the reference electrical property value, wherein the aggregate is formed in the channel by an interaction between the nucleic acid and a nucleic acid probe, wherein the nucleic acid probe is allowed to flow along the length of the channel,

thereby detecting the presence or absence of the nucleic acid in the sample.

2. The method of claim 1, further comprising:

prior to introducing the sample into the channel, measuring one or more electrical properties of the channel along at least the portion of the length of the channel; and

determining the reference electrical property value based on the one or more electrical properties of the channel measured during the previous measuring step.

3. The method of claim 1, further comprising:

introducing the nucleic acid probe into the channel prior to measurement of the electrical property value.

4. The method of claim 1, further comprising:

applying a potential difference across the length of the channel after introducing the sample into the channel and prior to detecting the measured electrical property value.

5. The method of claim 1, further comprising:

applying a potential difference across the length of the channel after introducing a nucleic acid probe into the channel and prior to detecting the reference electrical property value.

6. The method of claim 1, further comprising:

displaying, on a visual display device, an indication of whether the nucleic acid is present in the sample.

7. The method of claim 1, wherein the electrical property value corresponds to a value of an electrical current conducted along at least the portion of length of the channel or an electrical conductance along at least the portion of the length of the channel.

8. The method of claim 1, wherein the channel is configured to have a length ranging from 10 nanometers to 10 centimeters.

9. The method of claim 1, wherein the channel is configured to have a width ranging from 1 nanometer to 50 microns.

10. The method of claim 1, wherein the channel is configured to have a depth ranging from 1 nanometer to 1 micron.

11. The method of claim 1, further comprising:

determining whether an additional analyte is present in the channel based on the difference between the measured electrical property value and a second reference electrical property value.

12. The method of claim 1, further comprising:

monitoring a first set of one or more values of the electrical property in the channel during a first time period, and a second set of one or more values of the electrical property in the channel during a second time period;

selecting the reference electrical property value from the first set of values upon equilibration of the one or more values in the channel during the first time period; and

selecting the measured electrical property value from the second set of values upon equilibration of the one or more values in the channel during the second time period.

13. The method of claim 1, further comprising:

determining, based on the measured electrical property value, a concentration of the nucleic acid in the sample.

14. The method of claim 1, further comprising:

determining, based on the measured electrical property value, a concentration of the nucleic acid in the sample relative to a concentration of an additional analyte in the sample.

15. The method of claim 1, further comprising:

preparing the channel for reuse by introducing a de-aggregation agent into the channel, the de-aggregation agent causing disintegration of the aggregate.

16. A method for detecting a nucleic acid in a sample, the method comprising:

(a) introducing the sample into a channel comprising an inner space disposed between a first and a second electrode, wherein the channel has a length and a width, the length is substantially greater than the width;

(b) measuring an electrical property value of an electrical property along at least a portion of the length of the channel;

(c) accessing a reference electrical property value, wherein the reference electrical property value is associated with the electrical property of the channel along at least the portion of the length of the channel, wherein the reference electrical property value is obtained in the absence of the sample in the channel;

(d) comparing the measured electrical property value and the reference electrical property value; and

(e) detecting an aggregate in the inner space of the channel based on the comparison between the measured electrical property value and the reference electrical property value, wherein the aggregate is formed in the channel by an interaction between the nucleic acid and a nucleic acid probe, wherein the nucleic acid probe is allowed to flow along the length of the channel, thereby detecting the nucleic acid in the sample.