What is Claimed:

1. A system comprising:

a vessel system for a fluid;

a sampling assembly; and

a resonant sensor system coupled to the sampling assembly.

2. The system of claim 1 wherein the vessel system comprises a vessel system selected from among a group consisting of a desalter, a separator, a reactor, and a storage tank.

3. The system of claim 1 wherein the sampling assembly comprises at least one selected from among a group consisting of a dipstick, a swing arm, and a try-line.

4. The system of claim 1 further comprising a mixture disposed in the vessel system, the mixture having a first fluid and a second fluid normally immiscible with the first fluid, and wherein the resonant sensor system is configured to determine a relative content of the first fluid and the second fluid at a location in the vessel system.

5. The system of claim 1 wherein the resonant sensor system comprises subsystem that:

detects a set of signals from a resonant sensor system at a plurality of locations in the vessel system;

converts the set of signals to values of a complex impedance spectrum for the plurality of locations;

stores the values of the complex impedance spectrum and frequency values; and

determines a fluid phase inversion point from the values of the complex impedance spectrum.

6. The system of claim 4 wherein the mixture comprises an emulsion that is at least one of a water-in-oil emulsion and an oil-in-water emulsion.

7. The system of claim 1 wherein the resonant sensor system is configured to determine a fluid phase inversion point.

8. The system of claim 1 wherein the resonant sensor system is separated from direct contact with the fluid with a dielectric layer.

9. The system of claim 1 wherein the resonant sensor system is separated from direct contact with the fluid with a dielectric layer having a thickness of between 2 nm to 50 cm.

10. A method for measuring a level of a mixture of fluids in a vessel, the method comprising:

detecting a set of signals from a resonant sensor system at a plurality of locations in the vessel;

converting the set of signals to values of a complex impedance spectrum for the plurality of locations;

storing the values of the complex impedance spectrum and frequency values; and

determining a fluid phase inversion point from the values of the complex impedance spectrum.

11. A method as in claim 10 wherein converting the set of signals to values of the complex impedance spectrum comprises converting the set of signals to values of the complex impedance spectrum using multivariate data analysis.

12. A method as in claim 10 wherein determining the fluid phase inversion point comprises identifying the fluid phase inversion point from a change in the values of the complex impedance spectrum.

13. A method as in claim 10 wherein detecting signals from a resonant sensor system comprises:

disposing a resonant transducer in the mixture of fluids;

generating a transducer signal corresponding to changes in spectral resonance properties of the resonant transducer related to changes in properties of the mixture of fluids; and

reading the transducer signal.

14. A method for determining a composition of a mixture of oil and water in a vessel comprising:

determining a set of complex impedance spectrum values and conductivity values of the mixture of oil and water as a function of a height in the vessel with a resonant transducer;

determining a fluid phase inversion point from the set of complex impedance spectrum values;

applying an oil phase model to the set of complex impedance spectrum values, and conductivity values above the fluid phase inversion point; and

applying a water phase model to the set of complex impedance spectrum values and conductivity values below the fluid phase inversion point.

15. A method as in claim 14 further comprising generating a report indicating a relative content of oil and water and of the mixture of oil and water as a function of the height in the vessel.

16. A method as in claim 14 wherein the applying the oil phase model comprises converting the set of complex impedance spectrum values to a value of oil content in an oil-in-water mixture.

17. A method as in claim 14 wherein applying the water phase model comprises converting the set of complex impedance spectrum values into a value of water content in a water-in-oil mixture.

18. A method as in claim 14 wherein determining complex impedance spectrum values and conductivity values of the mixture of oil and water as a function of a height in the vessel with a resonant transducer comprises:

disposing a resonant transducer in the mixture of oil and water;

generating a set of transducer signals corresponding to changes in spectral resonance properties of the resonant transducer related to changes in properties of the mixture of oil and water; and

reading the set of transducer signals.

19. A method as in claim 18 further comprising processing the set of transducer signals though an impedance analyzer.

20. A method as in claim 14 wherein determining a fluid phase inversion point comprises determining a fluid phase inversion point from values for frequency and impedance.

21. A method for determining a composition of a mixture of a first fluid and a second fluid in a vessel comprising:

determining, with a sensor system, a set of complex impedance spectrum values of the mixture of the first fluid and the second fluid as a function of a height in the vessel;

determining a fluid phase inversion point from the set of complex impedance spectrum values;

applying a phase model of the first fluid to the set of complex impedance spectrum values above the fluid phase inversion point; and

applying a phase model of the second fluid to the set of complex impedance spectrum values below the fluid phase inversion point.

22. A method as in claim 21 wherein the sensor system is an electrical resonant transducer.

23. A method as in claim 21 wherein the first fluid is oil and the second fluid is water.

24. A method as in claim 21 wherein the mixture of the first fluid and the second fluid is an emulsion of an immiscible first fluid and an immiscible second fluid.

25. A method as in claim 23 further comprising deriving the phase model of the oil and the phase model of the water by calibrating the sensor system for 100% of the oil and 100% of the water.

26. A method as in claim 24 further comprising deriving the phase model of the first fluid and the phase model of the second fluid by calibrating the sensor system for 100% of the first fluid and 100% of the second fluid.

CLAIMS

1. A system comprising:

a vessel system for a fluid;

a sampling assembly; and

a resonant sensor system comprised of at least an electrically resonant transducer coupled to the sampling assembly, wherein the resonant sensor system measures values of real and imaginary parts of an impedance spectra associated with the electrically resonant transducer while proximate to the fluid and the measured values of real and imaginary parts of the impedance spectra associated with the electrically resonant transducer while proximate to the fluid are each independently used to determine a composition of the fluid, and wherein the resonant sensor system is configured to determine a fluid phase inversion point.

2. The system of claim 1 wherein the vessel system comprises a vessel system selected from among a group consisting of a desalter, a separator, a reactor, and a storage tank.

3. The system of claim 1 wherein the sampling assembly comprises at least one selected from among a group consisting of a dipstick, a swing arm, and a try-line.

4. The system of claim 1, wherein the fluid comprises a mixture disposed in the vessel system, the mixture having a first fluid and a second fluid normally immiscible with the first fluid, and wherein the resonant sensor system is configured to determine a relative content of the first fluid and the second fluid at a location in the vessel system.

5. The system of claim 4 wherein the mixture comprises an emulsion that is at least one of a water-in-oil emulsion and an oil-in-water emulsion.

6. The system of claim 1 wherein the resonant sensor system comprises subsystem that:

detects a set of signals from a resonant sensor system at a plurality of locations in the vessel system;

converts the set of signals to values of a complex impedance spectrum for the plurality of locations;

stores the values of the complex impedance spectrum and frequency values; and

determines a fluid phase inversion point from the complex impedance spectrum.

7. The system of claim 1 wherein the resonant sensor system is separated from direct contact with the fluid with a dielectric layer.

8. The system of claim 1 wherein the resonant sensor system is separated from direct contact with the fluid with a dielectric layer having a thickness of between 2 nm to 50 cm.

9. A method for measuring a level of a mixture of fluids in a vessel, the method comprising:

detecting a set of signals from a resonant sensor system at a plurality of locations in the vessel, wherein the resonant sensor system comprises at least an electrically resonant transducer;

converting the set of signals to values of real and imaginary parts of the impedance spectra for the plurality of locations;

storing the values of the real and imaginary parts of the impedance spectra and frequency values; and

determining a fluid phase inversion point from the independent values of the real and imaginary parts of the impedance spectra.

10. A method as in claim 9 wherein converting the set of signals to values of the real and imaginary parts of the impedance spectra comprises converting the set of signals to values of the real and imaginary parts of the impedance spectra using multivariate data analysis.

11. A method as in claim 9 wherein determining the fluid phase inversion point comprises identifying the fluid phase inversion point from a change in the values of the real and imaginary parts of the impedance spectra.

12. A method as in claim 9 wherein detecting signals from a resonant sensor system comprises:

disposing the electrically resonant transducer in the mixture of fluids;

generating a transducer signal corresponding to changes in spectral resonance properties of the electrically resonant transducer related to changes in properties of the mixture of fluids; and reading the transducer signal.

13. A method for determining a composition of a mixture of oil and water in a vessel comprising:

determining a set of complex impedance spectrum values and conductivity values of the mixture of oil and water as a function of a height in the vessel with an electrically resonant transducer, wherein the set of complex impedance spectrum values and conductivity values include real and imaginary parts of the impedance spectra;

determining a fluid phase inversion point from each of the independent values of real and imaginary parts of the impedance spectra;

applying an oil phase model to the set of complex impedance spectrum values, and conductivity values above the fluid phase inversion point; and

applying a water phase model to the set of complex impedance spectrum values and conductivity values below the fluid phase inversion point.

14. A method as in claim 13 further comprising generating a report indicating a relative content of oil and water and of the mixture of oil and water as a function of the height in the vessel.

15. A method as in claim 13 wherein the applying the oil phase model comprises converting the set of complex impedance spectrum values to a value of oil content in an oil-in-water mixture.

16. A method as in claim 13 wherein applying the water phase model comprises converting the set of complex impedance spectrum values into a value of water content in a water-in-oil mixture.

17. A method as in claim 13 wherein determining complex impedance spectrum values and conductivity values of the mixture of oil and water as a function of a height in the vessel with a resonant transducer comprises:

disposing the electrically resonant transducer in the mixture of oil and water;

generating a set of transducer signals corresponding to changes in spectral resonance properties of the resonant transducer related to changes in properties of the mixture of oil and water; and reading the set of transducer signals.

18. A method as in claim 17 further comprising processing the set of transducer signals through an impedance analyzer.

19. A method as in claim 13 wherein determining a fluid phase inversion point comprises determining a fluid phase inversion point from values for frequency and each of the independent values of real and imaginary parts of the impedance spectra.

20. A method for determining a composition of a mixture of a first fluid and a second fluid in a vessel comprising:

determining, with a sensor system, a set of complex impedance spectrum values of the mixture of the first fluid and the second fluid as a function of a height in the vessel, wherein the set of complex impedance spectrum values include real and imaginary parts of the impedance spectra;

determining a fluid phase inversion point from the independent values of the real and imaginary parts of the impedance spectra;

applying a phase model of the first fluid to the set of complex impedance spectrum values above the fluid phase inversion point; and

applying a phase model of the second fluid to the set of complex impedance spectrum values below the fluid phase inversion point.

21. A method as in claim 20 wherein the sensor system comprises an electrically resonant transducer.

22. A method as in claim 20 wherein the first fluid is oil and the second fluid is water.

23. A method as in claim 22 further comprising deriving the phase model of the oil and the phase model of the water by calibrating the sensor system for 100% of the oil and 100% of the water.

24. A method as in claim 20 wherein the mixture of the first fluid and the second fluid is an emulsion of an immiscible first fluid and an immiscible second fluid.

25. A method as in claim 24 further comprising deriving the phase model of the first fluid and the phase model of the second fluid by calibrating the sensor system for 100% of the first fluid and 100% of the second fluid.