Claims

1. A microfluidic system for monitoring the condition of lubricating oil comprising:
a microfluidic device comprising at least one microchannel configured to allow a sample of lubricating oil to pass therethrough as a laminar flow; and ~~a~~
at least one separating device configured to selectively separate at least one component from the lubricating oil in the fluid flow;
wherein the at least one separating device is a diffusion extractor configured to allow diffusion across parallel fluid streams;
wherein the microfluidic system comprises a detector device configured to detect the presence and/or measure at least one property of the at least one component passing through the microfluidic device after separation in the microchannel.

2. The microfluidic system according to claim 1 wherein the at least one microchannel comprises a plurality of inlets and outlets wherein a first inlet is configured to receive an oil sample and/or a second inlet is configured to receive a solvent.

3. The microfluidic system according to claim 1 or 2 wherein the at least one component from the lubricating oil is selected from the group consisting of metals, carboxylic acid, n-alkane insolubles and/or sulphur.

4. The microfluidic system according to any preceding claim wherein the detector device is located in, on, above, below or adjacent to the at least one microchannel.

5. The microfluidic system according to any preceding claim comprising at least one observation site.

6. The microfluidic system according to any preceding claim comprising a light source.

7. The microfluidic system according to any preceding claim wherein the detector device comprises at least one sensor selected from the group comprising a spectrometer, camera, CCD device, conductivity sensor, capacitance sensor and/or a metal responsive to a chemical analyte.

8. The microfluidic system according to claim 7 wherein the at least one sensor may be a spectrometer to detect, measure and/or record a spectrum from the at least one component of the lubricating oil.

9. The microfluidic system according to any preceding claim wherein the at least one component is detected or measured by measuring UV-absorption and/or measuring a difference in UV-Vis Absorption.

10. The microfluidic system according to any preceding claim wherein the at least one separation device ~~is selected from the group comprising a diffusion extractor,~~comprises a magnet and/or a metal-based sulphur removal device.

~~11. The microfluidic system according to claim 10 wherein the at least one separation device is a diffusion extractor.~~

~~12.~~11. The microfluidic system according to any preceding claim ~~11~~ wherein the diffusion extractor comprises a diffusion channel and the first inlet and/or second inlet are in fluid communication with the diffusion channel.

~~13.~~12. The microfluidic system according to any preceding ~~any of~~ claim~~s 11 or 12~~ wherein the diffusion extractor is a H-filter.

~~14.~~13. The microfluidic system according to claim 10 wherein the at least one separation device ~~is~~ comprises a magnet and the detector device is an electrical conductivity sensor and/or an electrical capacitance sensor.

~~15.~~14. The microfluidic system according to claim 10 wherein the separation device comprises~~is~~ a metal-based sulphur removal device selected from the group comprising copper or silver and the detector device comprises a camera and/or a CCD device.

~~16.~~15. The microfluidic system according to any preceding claim wherein the detector device is configured to measure a first component of the oil sample which may be used to infer or determine the presence or measurement level of a second component of the oil sample.

~~17.~~16. The microfluidic system according to any preceding claim comprising more than one separating device selected from the group comprising a diffusion extractor, a magnet and/or a metal-based sulphur removal device.

~~18.~~17. A method of monitoring the condition of lubricating oil comprising

~~providing~~ using a microfluidic system comprising:

a microfluidic device comprising at least one microchannel; ~~and~~

at least one separating device; and

a detector device;

passing a sample of the lubricating oil through the at least one microchannel in a laminar flow; ~~and~~

separating at least one component from the lubricating oil in the flow by diffusion across parallel fluid streams; and

detecting ~~detect~~ the presence and/or ~~measure~~ measuring at least one property of the at least one component passing through the microfluidic device after separation in the microchannel.

~~19.~~18. The method according to claim ~~18~~ 17 comprising detecting the presence and/or measuring at least one modal properties of the at least one component in the sample.

~~20.~~19. The method according to claim ~~19~~ 17 or claim 18 comprising detecting the presence of and/or measuring the at least one component by spectrometry, electrical conductivity, electrical capacitance and/or reactivity of the at least one component to a chemical indicator.

~~21.~~20. The method according to any of claims ~~19~~ 17 to 19~~or 20~~ comprising separating ~~the~~ at least one component from the lubricating oil sample by mass transfer~~, diffusion~~, magnetic attraction and/or chemical interaction.

~~22.~~21. The method according to any of claims ~~19~~ 17 to ~~21~~ 20 comprising taking at least one measurement of the lubricating oil sample before separating the at least one component and comparing with at least one measurement of the sample taken after the at least one component is separated.

~~23.~~22. The method according to any of claims ~~19~~ 17 to ~~22~~ 21 comprising comparing a spectrum of the lubricating oil sample before separating the at least one component with a spectrum of the extracted at least one component.

~~24.~~23. The method according to any of claims ~~19~~ 17 to ~~23~~ 22 comprising detecting, measuring and/or recording an electrical capacitance and/or electrical conductivity of the sample after the at least one component is separated or partially separated from the flow.

~~25.~~24. The method according to any of claims ~~19~~ 17 to ~~24~~ 23 comprising detecting, measuring and/or recording a chemical response of the at least one component to metal sensor and/or metal reagent.