CLAIMS

What is claimed is:

1. A dry eye analysis system using terahertz (THz) radiation, the system comprising:

a terahertz radiation measuring system comprising:

a terahertz radiation generator configured to project a THz wave onto a surface of an eye; and

a terahertz radiation detector configured to detect a reflected THz wave, said reflected THz wave being a reflection of the projected THz wave reflected from the surface of the eye as a result of projecting the THZ wave onto the surface of the eye;

a signal processing unit configured to communicate with the terahertz radiation detector to analyze properties of one or more layers of the eye in response to the THz wave reflected from the surface of the eye, the properties of the one or more layers of the eye comprising thickness of the eye's cornea and ambient tissues and amount of a plurality of chemical components in the one or more layers of the eye, wherein the signal processing unit is further configured to extract the analyzed properties of the one or more layers of the eye; and

a computing device coupled to the signal processing unit to receive the analyzed properties of the one or more layers of the eye and to determine therefrom a thickness of the cornea and a thickness of the ambient tissues of the one or more layers of the eye and an amount of a plurality of chemical components of the one or more layers of the eye to generate an evaluation of the dry eye conditions of the eye and present results of

the evaluation of the dry eye conditions of the eye and visual imaging of the analyzed properties of the cornea and/or the one or more layers of the eye.

2. The system of Claim 1 further comprising a smart box interface between the THz wave and the eye, the smart box interface comprising a smart box comprising low refractive index material and/or hydration absorption material for enhancement of sensitivity and/or selectivity of analysis of the properties of the one or more layers of the eye.

3. The system in accordance with either Claim 1 or Claim 2 wherein the chemical components of the eye's layers comprise a chemical component selected from collagen, hydration and keratocytes.

4. The system in accordance with Claim 1 wherein the computing device is configured to calculate a relative corneal composition of the chemical components in the eye's cornea.

5. The system in accordance with Claim 1 wherein the computing device is configured to determine an absolute corneal composition of the chemical components at positions of different cornea layer interfaces using a predefined calibration method, and wherein the different cornea layer interfaces comprise an interface between the eye's cornea and a layer selected from an epithelium layer, a stromal layer, and an endothelium layer.

6. The system in accordance with Claim 5 wherein the computing device is configured to calculate a point value that is an absolute corneal hydration for at least one local region of the eye's cornea.

7. The system in accordance with Claim 1 wherein the computing device is configured to calculate an overall average of one or both of the thickness or the chemical components of the eye's cornea in response to the THz wave reflected from the surface of the eye using a predetermined model.

8. The system in accordance with any of the preceding claims wherein the terahertz radiation measuring system further comprises an illumination optical system coupled to the terahertz radiation generator to provide oblique-angle terahertz radiation illumination of the surface of the eye and coupled to the terahertz radiation detector to provide the reflected wave thereto.

9. The system in accordance with Claim 8 wherein the illumination optical system comprises two off-axis parabolic (OAP) mirrors,

wherein a first mirror of the two OAP mirrors is arranged in an optical path of the terahertz radiation generator and is configured to receive the THz wave emitted from the terahertz radiation generator and reflect at least a portion of the THz wave to be project the at least a portion of the THz wave onto the surface of the eye, and

wherein a second mirror of the two OAP mirrors is arranged in a symmetrical position to the first mirror with respect to the eye and is configured to receive at least a portion of the THz wave reflected from the eye.

10. The system in accordance with any of the preceding claims wherein the terahertz radiation detector is configured to detect the reflected wave within a frequency band of 0.1 THz to 10 THz.

11. The system in accordance with any of the preceding claims wherein the terahertz radiation generator comprises:

a femtosecond laser configured to generate the THz wave; and

a terahertz radiation signal emitter configured to emit the THz wave onto the surface of the eye.

12. The system in accordance with any of the preceding claims wherein the computing device comprises a user interface configured to display the visual imaging of the analyzed properties of the cornea and/or the one or more layers of the eye.

13. The system in accordance with Claim 12 wherein the computing device is further coupled to the terahertz radiation measuring system, and wherein the user interface is further configured to enable control of the terahertz radiation measuring system.

14. A dry eye analysis method using terahertz (THz) radiation, the method comprising the steps of:

projecting a THz wave onto a surface of an eye;

detecting a reflected THz wave being a reflection of the projected THz wave reflected from the surface of the eye as a result of projecting the THz wave onto the surface of the eye; and

analyzing properties of one or more layers of the eye in response to the THz wave reflected from the surface of the eye, the properties of the one or more layers of the eye comprising thickness of the eye's cornea and ambient tissues amount of a plurality of chemical components in the one or more layers of the eye;

extracting the analyzed properties of the one or more layers of the eye;

determining the thickness of the cornea and the thickness of the ambient tissues of the one or more layers of the eye and an amount of a plurality of chemical components of the one or more layers of the eye;

generating an evaluation of the dry eye conditions of the eye; and

presenting the evaluation of the dry eye conditions of the eye and visual imaging of the analyzed properties of the cornea and/or the one or more layers of the eye.

15. The method in accordance with Claim 14 wherein the chemical components of the eye's layers comprise a chemical component selected from collagen, hydration and keratocytes.

16. The method in accordance with Claim 14 wherein the step of analyzing the properties of the one or more layers of the eye comprises calculating a relative corneal composition of the chemical components in the eye's cornea.

17. The method in accordance with Claim 14 wherein the step of analyzing the properties of the one or more layers of the eye comprises determining an absolute corneal composition of the chemical components at positions of different cornea layer

interfaces using a predefined calibration method, wherein the different cornea layer interfaces comprise an interface between the eye's cornea and a layer selected from an epithelium layer, a stromal layer, and an endothelium layer.

18. The method in accordance with Claim 17 wherein determining the absolute corneal composition of the chemical components comprises calculating a point value that is an absolute corneal hydration for at least one local region of the eye's cornea.

19. The method in accordance with Claim 17 wherein determining the absolute corneal composition of the chemical components comprises calculating an overall average of one or both of the thickness or the chemical components of the eye's cornea in response to the THz wave reflected from the surface of the eye using a predetermined model.

20. A computer readable medium comprising instructions which, when executed by a system, make the system perform a method for dry eye analysis using terahertz (THz) radiation according to any one of Claims 14 to 19.