WHAT IS CLAIMED IS:

1. A system for use in inspecting a coating ~~(112)~~ on a substrate ~~(110)~~, the system comprising:

a platform ~~(102)~~ configured to receive a sample ~~(108)~~ including the substrate ~~(110)~~ having the coating ~~(112)~~ deposited thereon;

a light source ~~(104)~~ configured to direct a plurality of electromagnetic pulses ~~(114)~~ towards a scanning location ~~(116)~~ on the coating ~~(112)~~, wherein the light source ~~(104)~~ is oriented to direct the plurality of electromagnetic pulses ~~(114)~~ at an oblique angle relative to a surface ~~(118)~~ of the coating ~~(112)~~;

a light detector ~~(106)~~ configured to receive electromagnetic pulses ~~(114)~~ reflected from the sample ~~(108)~~, wherein a first portion ~~(142)~~ of each electromagnetic pulse ~~(114)~~ is reflected from the surface ~~(118)~~ of the coating ~~(112)~~ at an interface between the coating ~~(112)~~ and an ambient environment, and wherein a second portion ~~(144)~~ of each electromagnetic pulse ~~(114)~~ is reflected from a surface ~~(118)~~ of the substrate ~~(110)~~ at an interface between the coating ~~(112)~~ and the substrate ~~(110)~~; and

an actuator ~~(124)~~ coupled to at least one of the platform ~~(102)~~ and the light source ~~(104)~~, wherein the actuator ~~(124)~~ is configured to move the platform ~~(102)~~ and the light source ~~(104)~~ relative to each other such that the plurality of electromagnetic pulses ~~(114)~~ are directable towards the scanning location ~~(116)~~ from different rotational positions~~.~~; and

a computing device in communication with the light detector, the computing device configured to:

determine a time delay between reception of the first portion and the second portion of each reflected electromagnetic pulse at the light detector, thereby defining a plurality of time delays; and

analyze the plurality of time delays to assess a microstructure of the coating by determining a standard deviation value for each of the plurality of time delays associated with each sample, grouping the plurality of standard deviation values based on relative differences in the plurality of standard deviation values, and assessing the microstructure of the coating of each sample based on the grouping.

~~2. The system in accordance with Claim 1 further comprising a computing device (122) in communication with the light detector (106), the computing device (122) configured to:~~

~~determine a time delay between reception of the first portion (142) and the second portion (144) of each reflected electromagnetic pulse at the light detector (106), thereby defining a plurality of time delays; and~~

~~analyze the time delays to assess a microstructure of the coating (112).~~

~~3~~2. The system in accordance with Claim 1, wherein the actuator ~~(124)~~ is coupled to the platform ~~(102)~~, and is configured to rotate the platform ~~(102)~~ relative to the light source ~~(104)~~.

~~4~~3. The system in accordance with Claim 1, wherein the actuator ~~(124)~~ is coupled to the light source ~~(104)~~, and is configured to rotate the light source ~~(104)~~ about the platform ~~(102)~~.

~~5~~4. A method of inspecting a coating ~~(112)~~ on a substrate ~~(110)~~, the method comprising:

directing a plurality of electromagnetic pulses ~~(114)~~ towards a scanning location ~~(116)~~ on the coating ~~(112)~~, each electromagnetic pulse ~~(114)~~ directed from a different rotational position relative to the scanning location ~~(116)~~, and each electromagnetic pulse ~~(114)~~ directed at an oblique angle relative to a surface ~~(118)~~ of the coating ~~(112)~~, wherein a first portion ~~(142)~~ of each electromagnetic pulse ~~(114)~~ is reflected from the surface ~~(118)~~ of the coating ~~(112)~~, and wherein a second portion ~~(144)~~ of each electromagnetic pulse ~~(114)~~ is reflected from a surface ~~(118)~~ of the substrate ~~(110)~~ at an interface between the coating ~~(112)~~ and the substrate ~~(110)~~;

determining a time delay between reception of the first portion ~~(142)~~ and the second portion ~~(144)~~ of each reflected electromagnetic pulse at a light detector ~~(106)~~, thereby defining a plurality of time delays; and

analyzing the plurality of time delays to assess a microstructure of the coating ~~(112).~~.

wherein analyzing the plurality of time delays to assess a microstructure of the coating comprises:

determining a standard deviation value for each of the plurality of time delays associated with each sample;

grouping the plurality of standard deviation values based on relative differences in the plurality of standard deviation values;

and assessing the microstructure of the coating of each sample based on the grouping.

~~6~~5. The method in accordance with Claim ~~5~~4, wherein analyzing the time delays comprises determining a standard deviation of the time delay for each of the plurality of electromagnetic pulses. ~~(114),~~

6. The method in accordance with Claim 5 ~~the method~~ further comprising comparing the standard deviation to a predetermined threshold, wherein a first microstructure is determined when the standard deviation is greater than the predetermined threshold, and wherein a second microstructure is determined when the standard deviation is less than the predetermined threshold.

7. The method in accordance with Claim ~~5~~4, wherein directing a plurality of electromagnetic pulses ~~(114)~~ comprises directing the plurality of electromagnetic pulses ~~(114)~~ having a wavelength in the terahertz frequency range.

8. The method in accordance with Claim ~~5~~4, wherein directing a plurality of electromagnetic pulses ~~(114)~~ comprises:

emitting the plurality of electromagnetic pulses ~~(114)~~ from a light source ~~(104)~~; and

rotating at least one of the substrate ~~(110)~~ and the light source ~~(104)~~.

9. The method in accordance with Claim 8, wherein rotating at least one of the substrate ~~(110)~~ or the light source ~~(104)~~ comprises positioning the light source ~~(104)~~ within a rotational range defined between about 0 degrees and about 360 degrees relative to the scanning location ~~(116)~~.

~~9~~10. The method in accordance with Claim ~~5~~4 further comprising:

providing a visual cue ~~(130)~~ on the coating ~~(112)~~ at the scanning location ~~(116)~~; and

directing the plurality of electromagnetic pulses ~~(114)~~ towards the visual cue ~~(130)~~ from each rotational position.

~~10~~11. A method of assessing a coating ~~(112)~~ microstructure, the method comprising:

providing a plurality of samples ~~(108)~~ each having a substrate ~~(110)~~ and a coating ~~(112)~~ deposited thereon;

evaluating each sample ~~(108)~~ with a plurality of electromagnetic pulses ~~(114)~~ that are each directed from a different rotational position relative to each of the respective sample ~~(108)~~;

obtaining time delay data associated with the plurality of electromagnetic pulses ~~(114)~~ being reflected from the plurality of samples ~~(108)~~, wherein a time delay is defined by receiving a first portion ~~(142)~~ and a second portion ~~(144)~~ of each electromagnetic pulse ~~(114)~~ reflected from each sample ~~(108)~~ at different points in time; and

assessing a microstructure of the coating ~~(112)~~ on the plurality of samples ~~(108)~~ based on a comparison of the time delay data associated with the plurality of samples ~~(108).~~.

wherein assessing the microstructure of the coating on the plurality of samples based on a comparison of the time delay data associated with the plurality of samples comprises:

determining a standard deviation of the time delay data associated with each sample;

grouping the standard deviation values based on relative differences in the standard deviation values; and

assessing the microstructure of the coating of each sample based on the grouping.

~~11. The method in accordance with Claim 10, wherein assessing a microstructure comprises:~~

~~determining a standard deviation of the time delay data associated with each sample (108);~~

~~grouping the standard deviation values based on relative differences in the standard deviation values; and~~

~~assessing the microstructure of the coating (112) of each sample (108) based on the grouping.~~

12. The method in accordance with Claim 11, wherein grouping the standard deviation values comprises defining a first cluster ~~(188)~~ and a second cluster ~~(190)~~, the first cluster ~~(188)~~ and the second cluster ~~(190)~~ being separated by a value that is greater than a maximum difference in standard deviation values contained in either the first cluster ~~(188)~~ or the second cluster ~~(190),~~.

13. The method in accordance with Claim 12, the method further comprising ~~and~~ wherein assessing the microstructure comprises:

determining the microstructure is anisotropic when the standard deviation of a sample ~~(108)~~ is included in the first cluster ~~(188)~~; and

determining the microstructure is isotropic when the standard deviation of a sample ~~(108)~~ is included in the second cluster ~~(190)~~.

~~13~~14. The method in accordance with Claim ~~10~~11, wherein evaluating each sample ~~(108)~~ comprises directing the plurality of electromagnetic pulses ~~(114), having a wavelength in the terahertz frequency range,~~ towards a scanning location ~~(116)~~ on the

coating ~~(112)~~, each electromagnetic pulse ~~(114)~~ directed at an oblique angle relative to a surface ~~(118)~~ of the coating ~~(112)~~, wherein the first portion ~~(142)~~ of each electromagnetic pulse ~~(114)~~ is reflected from the surface ~~(118)~~ of the coating ~~(112)~~, and wherein the second portion ~~(144)~~ of each electromagnetic pulse ~~(114)~~ is reflected from a surface ~~(118)~~ of the substrate ~~(110)~~.

15. The method in accordance with Claim 14, wherein directing a plurality of electromagnetic pulses comprises directing the plurality of electromagnetic pulses having a wavelength in the terahertz frequency range.

~~14~~16. The method in accordance with Claim ~~13~~14, wherein directing a plurality of electromagnetic pulses ~~(114)~~ comprises:

emitting the plurality of electromagnetic pulses ~~(114)~~ from a light source ~~(104)~~; and

rotating at least one of the substrate ~~(110)~~ and the light source ~~(104)~~;.

17. The method in accordance with Claim 16, wherein rotating at least one of the substrate ~~(110)~~ or the light source ~~(104)~~ comprises positioning the light source ~~(104)~~ within a rotational range defined between about 0 degrees and about 360 degrees relative to the scanning location ~~(116)~~.

~~15~~18. The method in accordance with Claim ~~10~~11 further comprising:

providing a visual cue ~~(130)~~ on the coating ~~(112)~~ at a scanning location ~~(116)~~; and

directing the plurality of electromagnetic pulses ~~(114)~~ towards the visual cue ~~(130)~~ from each rotational position.