reference point x_B on the single reference surface corresponding to the interrogation pulses output at the first time T_a, and at the second time, T_b, wherein the first reference point x_A and the second reference point x_B are points on the single reference surface that are outside of the sample area, wherein the controller further calculates a corrected air scan profile by performing a correction of the air scan profile received at the first time, T_a, based on the air distance measurements at points x_A and x_B received at the first time, T_a, and at the second time, T_b, and determines the thickness profile of the sample based on the corrected air scan profile and the sample scan profile.

[0004] In some examples, the single reference surface comprises one of a surface of a substantially planar reference beam and a surface of an idler roll.

[0005] In some examples, the reference beam is comprised of a material having a coefficient of thermal expansion of less than 20.0 ppm/°C.

[0006] In some examples, the time-domain terahertz (THz) measurement system of claim 1 further comprises a first support beam supporting the reference beam at a first mounting point, and a second support beam supporting the reference beam at a second mounting point, wherein at least one of the first mounting point and the second mounting point is a non-fixed mounting point.

[0007] In some examples, the first mounting point is a fixed mounting point and the second mounting point is a non-fixed mounting point.

[0008] In some examples, the reference beam is supported at a first mounting point and at a second mounting point, and at least one of the first mounting point and the second mounting point is a non-fixed mounting point.

[0009] In some examples, the non-fixed mounting point includes one of a slot and a flexure mount.

[0010] In some examples, the reference beam is comprised of one of stainless steel or Invar ($Fe_{0.64}Ni_{0.36}$).

[0011] In some examples, the terahertz transmitter and the terahertz receiver are housed within a terahertz probe head.

[0012] In some examples, the time-domain terahertz (THz) measurement system further comprises a carriage slidably moveable along the scanning frame, the THz probe head mounted to the carriage to be slidably moveable along the scanning frame.

[0013] In some examples, the controller further calculates an effective refractive index profile of the sample based on the thickness profile of the sample.

[0014] In some examples, the controller further calculates at least one of a composition, a density, a mass, a void fraction, a mass fraction, a volume fraction, a mass per unit area, and a porosity of the sample based on the thickness profile of the sample.

[0015] In some examples, the thickness profile of the sample may be input to control a manufacturing process.

[0016] In another example, the disclosure is directed to a method of determining a thickness profile of a sample, comprising outputting terahertz interrogation pulses into a sample area of a terahertz measurement system at a first time, T_a, when no sample is present in the sample area, receiving an air scan profile including pulses reflected from a single reference surface corresponding to the interrogation signals output at the first time, T_a, outputting terahertz interrogation pulses into the sample area at a second time, T_b, when the sample is present in the sample area, receiving a sample scan profile including pulses reflected from the single reference surface corresponding to the interrogation pulses output at the second time, T_b, and including pulses reflected from the sample corresponding to the interrogation pulses output at the second time, T_b, receiving air distance measurements including pulses reflected at a first reference point x_A on the single reference surface corresponding to the interrogation pulses output at the first time first time, T_a, and at the second time, T_b and including pulses reflected at a second reference point x_B on the single reference surface corresponding to the interrogation pulses output at first time, T_a, and at the second time, T_b, wherein x_A and x_B are points on the single reference surface that are outside of the sample area, calculating a corrected air scan profile by performing a correction of the air scan profile received at the first time, T_a, based on the air distance measurements received at the first time, T_a, and at second time, T_b, and determining the thickness profile of the sample based on the corrected air scan profile and the sample scan profile.

[0017] In some examples, the reference beam is comprised of a material having a coefficient of thermal expansion of less than 20.0 ppm/°C.

[0018] In some examples, the reference beam is supported at a first mounting point and at a second mounting point, and wherein at least one of the first mounting point and the second mounting point is a non-fixed mounting point.

[0019] In some examples, the first mounting point is a fixed mounting point and the second mounting point is a non-fixed mounting point.

[0020] In some examples, the method further includes calculating an effective refractive index profile of the sample based on the thickness profile of the sample.

[0021] In some examples, the method further includes calculating at least one of a composition, a density, a mass, a void fraction, a mass fraction, a volume fraction, a mass per unit area, and a porosity of the sample based on the thickness profile of the sample.

[0022] In some examples, the method further includes controlling a manufacturing process based on the thickness profile of the sample.