

CLAIMS

What is claimed is:

1. A system comprising:
 - a transparent crystal, wherein at least part of the transparent crystal is embedded within a wall and a liner of a processing chamber, the transparent crystal having a proximal end and a distal end, the distal end having a distal surface that is exposed to an interior of the processing chamber;
 - a transparent thin film deposited on the distal surface of the transparent crystal, the transparent thin film having chemical properties substantially matching those of the liner;
 - a spectrometer; and
 - a light coupling device coupled to the spectrometer, the light coupling device to:
 - transmit light, from a light source, through the proximal end of the transparent crystal; and
 - focus, into the spectrometer, light received reflected back from a combination of the distal surface, a surface of the transparent thin film, and a surface of a process film layer deposited on the transparent thin film; and
 - wherein the spectrometer is to detect a first spectrum within the focused light that is representative of the process film layer.
2. The system of claim 1, wherein the transparent thin film comprises one of yttrium oxide, aluminum oxide, or zirconium oxide and is of a known thickness.
3. The system of claim 1, wherein the transparent crystal is one of a sapphire plug, a diamond plug, a quartz plug, or a silicon carbide plug.
4. The system of claim 1, wherein the distal surface of the transparent crystal is formed at an angle with respect to the liner, the angle being between 0.8 and 1.8 degrees.
5. The system of claim 1, further comprising a processing device coupled to the spectrometer, the processing device to:
 - receive, from the spectrometer, the first spectrum;
 - receive, from the spectrometer, a second spectrum when the light source is off;

- calculate reflectometry data via subtraction of the second spectrum from the first spectrum;
- calculate a reflectometry signal via division of the reflectometry data by a reference spectrum; and
- fit the reflectometry signal to a thin film optical model to determine information comprising one or more optical film property of the process film layer.
6. The system of claim 5, wherein the one or more optical film property comprises thickness, and wherein, during processing substrates within the processing chamber, the processing device is further to:
- compare the thickness with a baseline measurement for the process film layer;
- determine, using the comparison, a variation in a rate of deposition of the process film layer that is beyond a threshold variation; and
- trigger a process within the processing chamber that is to correct the rate of deposition of the process film layer.
7. The system of claim 5, wherein the one or more optical film property comprises thickness, and wherein, after processing a substrate within the processing chamber, the processing device further to:
- detect a moment in time at which the process film layer on the transparent thin film has been removed within a predetermined threshold thickness; and
- in response to the detection, trigger the processing device to end a cleaning process within the processing chamber.
8. The system of claim 5, wherein the one or more optical film property comprises thickness, and wherein, during processing substrates within the processing chamber, the processing device further to:
- detect a moment in time when the process film layer has reached a threshold level of thickness on the transparent thin film; and
- trigger an end of a deposition process that is depositing the process film layer.
9. A processing chamber comprising:
- a wall to define an interior of the processing chamber;
- a liner attached to an inside surface of the wall;

a transparent crystal, wherein at least part of the transparent crystal is embedded within the wall and the liner, the transparent crystal having a proximal end and a distal end, the distal end having a distal surface that is approximately flush with the inside surface of the wall; and

a transparent thin film deposited on the distal surface of the transparent crystal, the transparent thin film having chemical properties substantially matching those of the liner, wherein light from outside of the wall is to pass through the transparent crystal and reflect off the distal surface and off a surface of the transparent thin film back through the proximal end of the transparent crystal.

10. The processing chamber of claim 9, wherein the transparent thin film comprises one of yttrium oxide, aluminum oxide, or zirconium oxide and is of a known thickness.

11. The processing chamber of claim 9, wherein the transparent crystal is one of a sapphire plug, a diamond plug, a quartz plug, or a silicon carbide plug.

12. The processing chamber of claim 9, wherein the distal surface of the transparent crystal is formed at an angle with respect to the liner, the angle being between 0.8 and 1.8 degrees.

13. The processing chamber of claim 9, wherein the transparent crystal is plug-shaped and comprises:

a shaft that is embedded within the wall and the liner; and

a flange that is attached to the shaft and abuts an outside surface of the wall, wherein the processing chamber further comprises a seal positioned between the flange and the outside surface of the wall.

14. The processing chamber of claim 13, wherein the flange comprises an inner surface that is in physical contact with the seal, the inner surface comprising a surface roughness (Ra) of less than 20 nanometers.

15. The processing chamber of claim 13, wherein a proximal surface at the proximal end of the transparent crystal is formed at an angle with respect to the outside surface of the wall, the angle being between 2 and 5 degrees.

16. A method comprising:
- providing at least part of a transparent crystal embedded within a wall and a liner of a processing chamber, the transparent crystal having a proximal end and a distal end, the distal end having a distal surface that is exposed to an interior of the processing chamber;
 - depositing, on the distal surface of the transparent crystal, a transparent thin film comprising chemical properties substantially matching those of the liner;
 - depositing, on the transparent thin film within the processing chamber, a process film layer;
 - transmitting light, from a light source by a light coupling device, through the proximal end of the transparent crystal;
 - focusing, by the light coupling device into a fiber optic cable, light received reflected back from a combination of the distal surface, a surface of the transparent thin film, and a surface of the process film layer;
 - receiving, by a spectrometer, the focused light from the fiber optic cable; and
 - detecting, by the spectrometer within the focused light, a first spectrum that is representative of the process film layer.
17. The method of claim 16, further comprising:
- detecting, by the spectrometer, a second spectrum from the focused light when the light source is off;
 - receiving, by a processing device, the first spectrum and the second spectrum;
 - subtracting, by the processing device, the second spectrum from the first spectrum to generate a reflectometry data;
 - dividing, by the processing device, the reflectometry data by a reference spectrum to generate a reflectometry signal; and
 - fit, by the processing device, the reflectometry signal to a thin film optical model to determine information comprising one or more optical film property of the process film layer.
18. The method of claim 17, wherein the one or more optical film property comprises thickness, and wherein, during processing substrates within the processing chamber, the method further comprising:
- comparing the thickness with a baseline measurement for the process film layer;
 - determining, using the comparison, a variation in a rate of deposition of the process film layer that is beyond a threshold variation; and

triggering a process within the processing chamber that is to correct the rate of deposition of the process film layer.

19. The method of claim 17, wherein the one or more optical film property comprises thickness, and the method further comprising:

detecting that the thickness of the process film layer on the transparent thin film has reached an accumulation limit; and

in response to the detecting, triggering the processing chamber to initiate a cleaning process in the processing chamber.

20. The method of claim 17, wherein the one or more optical film property comprises thickness, and wherein, after processing a substrate within the processing chamber, the method further comprising:

detecting a moment in time at which the process film layer on the transparent thin film has been removed by a cleaning process within a predetermined threshold thickness; and

in response to the detecting, triggering the processing device to end the cleaning process within the processing chamber.

21. The method of claim 17, wherein the one or more optical film property comprises thickness, and wherein, during processing substrates within the processing chamber, the method further comprising:

detecting a moment in time when the process film layer has reached a threshold level of thickness on the transparent thin film; and

triggering an end of a deposition process that is depositing the process film layer.