Claims

~~1.~~ 1. A system, comprising:

a controller, wherein the controller includes one or more processors and memory configured to store one or more sets of program instructions, wherein the one or more processors are configured to execute the one or more sets of program instructions, wherein the one or more sets of program instructions are configured to cause the one or more processors to:

perform ~~at least~~ a first wafer geometry characterization process via at least one interferometer tool of one or more characterization sub-systems prior to a first lithography process on a semiconductor wafer; perform at least one characterization process via at least one reflection-mode characterization tool of the one or more characterization sub-systems following the first lithography process and prior to at least one discrete backside film deposition process on ~~a semiconductor wafer;~~

the semiconductor wafer, wherein the at least one characterization process comprises a film property characterization process or an intensity spectra characterization process; perform at least an additional characterization process via at least one reflection-mode characterization tool of the one or more characterization sub-systems ~~-~~ following the at least one discrete backside film deposition process on the semiconductor wafer~~;~~

and prior to a second lithography process, wherein the at least the additional characterization process comprises a film property characterization process or an intensity spectra characterization process; perform a second wafer geometry characterization process via at least one interferometer tool of the one or more characterization sub-systems prior to the second lithography process on the semiconductor wafer; determine at least one of a film force or one or more in-plane displacements for at least one discrete backside film deposited on the semiconductor wafer via the at least one discrete backside film deposition process based on the at least the first wafer geometry characterization process ~~and the~~, the at least one characterization process, the at least the additional characterization process, and the second wafer geometry characterization process; and

provide at least one of the film force or the one or more in-plane displacements to at least one process tool via at least one of a feed forward loop or a feedback loop to improve performance of one or more fabrication processes~~,~~.

~~wherein at least one of the at least the first characterization process or the at least the additional characterization process comprises at least one of one or more film property characterization processes or one or more intensity spectra characterization processes.~~

~~2.~~ 2. The system in ~~Claim 1,~~claim 1, wherein the one or more film property characterization processes are configured to characterize ~~at least one of~~ a thickness, a real component of an index of refraction, ~~or~~and a complex component of the index of refraction of the at least one discrete backside film deposited on the semiconductor wafer via the at least one discrete backside film deposition process.

~~semiconductor wafer via the at least one discrete backside film deposition process.~~

~~3. The system in Claim 1, wherein the one or more characterization sub-systems comprise at least one reflection-mode characterization tool configured to perform at least one of the one or more film properties characterization processes or the one or more intensity spectra characterization processes on the semiconductor wafer.~~

~~4.~~ 3. The system in claim 2, wherein the index of refraction of the semiconductor wafer is calibrated against reference data obtained for a calibration wafer set.

4. The system in ~~Claim 3,~~claim 1, wherein at least one of the at least ~~the first~~one characterization process ~~and~~or the at least the additional characterization process further comprise one or more wafer geometry characterization processes on the semiconductor wafer~~.~~

~~5. The system in Claim 4, wherein the one or more characterization sub-systems comprise~~ performed via at least one interferometer tool ~~configured to perform~~of the one or more ~~wafer geometry~~ characterization ~~processes on the semiconductor wafer~~sub-systems.

~~6. The system in Claim 5, wherein the at least one reflection-mode characterization tool and the at least one interferometer tool are integrated characterization tools within the characterization sub-system.~~

~~7. The system in Claim 5, wherein the at least one reflection-mode characterization tool and the at least one interferometer tool are stand-alone characterization tools within the characterization sub-system.~~

~~8. The system in Claim 4,~~5. The system in claim 4, wherein the at least one process tool is configured to perform the one or more fabrication processes on the semiconductor wafer.

~~9.~~ 6. The system in ~~Claim 8,~~claim 5, wherein the at least one process tool comprises at least one film deposition tool configured to perform one or more discrete frontside film deposition processes on the semiconductor wafer.

~~10.~~ 7. The system in ~~Claim 8,~~claim 5, wherein the at least one process tool comprises at least one film deposition tool configured to perform one or more discrete backside film deposition processes on the semiconductor wafer.

~~11.~~ 8. The system in ~~Claim 8,~~claim 5, wherein the at least one process tool comprises at least one lithography tool configured to perform one or more lithography processes on the semiconductor wafer.

~~12.~~ 9. The system in ~~Claim 11,~~claim 8, wherein the one or more sets of program instructions are further configured to cause the one or more processors to:

provide at least one of the film force or the one or more in-plane displacements to the one or more characterization sub-systems via at least one of the feed forward loop or the feedback loop to improve performance of the at least the first characterization process or the at least the additional characterization process.

13. 10. The system in Claim 11,claim 5, wherein the one or more sets of program instructions are configured to causesemiconductor wafer is transferred between the one or more processors to:

perform characterization sub-systems and the at least one process tool for the first characterization process, including:

perform at least one of the one or more wafer geometry characterization processes prior to at least one of the one or moreprocess, the first lithography processes; and

performprocess, the at least one of the one or more film property characterization processes following the at least one of the one or more lithography processes and prior toprocess, the at least one discrete backside film deposition process; and

perform, the at least the additional characterization process, including:

perform at least one of the one or more film property characterization processes following the at least one discrete backside film deposition process and prior to at least an additional of the one or more lithography processes; and

perform an additional the second wafer geometry characterization process following the at least one discrete backside film deposition process and prior to the at least the additional of the one or more lithography processes, and the second lithography process.

14. 11. The system in Claim 11,claim 10, wherein the semiconductor wafer is transferred between the one or more sets of program instructions are configured to cause the one or more processors to:

perform the at least the first characterization sub-systems and the at least one process, including:

perform tool for the first wafer geometry characterization process, the first lithography process, the at least one of the one or more wafer

geometry characterization processes prior to at least one of the one or more lithography processes; and

perform at least one of the one or more intensity spectra characterization processes following the at least one of the one or more lithography processes and prior toprocess, the at least one discrete backside film deposition process; and

perform, the at least one discrete frontside film deposition process, the at least the additional characterization process, including:

perform at least one of the one or more intensity spectra characterization processes following the at least one discrete backside film deposition process and prior to at least an additional of the one or more lithography processes; and

perform an additional the second wafer geometry characterization process following the at least one discrete backside film deposition process and prior to the at least the additional of the one or more lithography processes, and the second lithography process.

15. 12. The system in Claim 11,claim 1, wherein the one or more sets of program instructions are configured to cause the one or more processors to:

perform the at least the first at least one reflection-mode characterization tool and the at least one interferometer tool are integrated characterization process, including:

perform at least one of the one or more wafer geometry tools within the characterization processes prior to at least one of the one or more lithography processes; andsub-system.

perform13. The system in claim 1, wherein the at least one reflection-mode characterization tool and the at least one interferometer tool are stand-alone characterization tools within the characterization sub-system.

14. The system in claim 1, wherein data from at least one of the at least one characterization process or the at least the additional characterization process, including:

perform is inputted into a learning algorithm, wherein the learning algorithm generates a learned model based on the data from reference data and the at least one of the at least one or more film property characterization processesprocess or the one or more intensity spectra characterization processes followingat least the additional characterization process, wherein the learned model determines the at least one of a film force or one or more in-plane displacements for at least one discrete backside film deposited on the semiconductor wafer via the at least one discrete backside film deposition process and prior to at least an additional of the one or more lithography processes; and.

perform an additional wafer geometry characterization process following the at least one discrete backside film deposition process and prior to the at least the additional of the one or more lithography processes.

16. The system in Claim 1, wherein the one or more sets of program instructions are configured to cause the one or more processors to:

perform the at least the first characterization process, including:

perform at least one of the one or more film property characterization processes or the one or more intensity spectra 15. A system, comprising:

one or more characterization processes following at least one of the one or more lithography processes and prior to the at least one discrete backside film deposition process; and

perform the at least the additional characterization process, including:

perform at least one of the one or more film property characterization processes or the one or more intensity spectra characterization processes following the at least one discrete backside film deposition process and prior to at least an additional of the one or more lithography processes.

17. A system, comprising:

a characterization sub-system; and

———sub-systems; and a controller, wherein the controller includes one or more processors and memory configured to store one or more sets of program instructions, wherein the one or more processors are configured to execute the one or more sets of program instructions, wherein the one or more sets of program instructions are configured to cause the one or more processors to:

perform ~~at least~~ a first wafer geometry characterization process via at least one ~~or more characterization sub-systems~~interferometer tool of the one or more characterization sub-systems prior to a first lithography process on a semiconductor wafer; perform at least one characterization process via at least one reflection-mode characterization tool of the one or more characterization sub-systems following the first lithography process and prior to at least one discrete backside film deposition process on ~~a semiconductor wafer;~~

the semiconductor wafer, wherein the at least one characterization process comprises a film property characterization process or an intensity spectra characterization process; perform at least an additional characterization process via at least one reflection-mode characterization tool of the one or more characterization sub-systems following the at least one discrete backside film deposition process on the semiconductor wafer~~;~~

and prior to a second lithography process, wherein the at least the additional characterization process comprises a film property characterization process or an intensity spectra characterization process; perform a second wafer geometry characterization process via at least one interferometer tool of the one or more characterization sub-systems prior to the second lithography process on the semiconductor wafer; determine at least one of a film force or one or more in-plane displacements for at least one discrete backside film deposited on the semiconductor wafer via the at least one discrete backside film deposition process based on the at least the first wafer geometry characterization process ~~and the~~, the at least one characterization process, the at least the additional characterization process, and the second wafer geometry characterization process; and

provide at least one of the film force or the one or more in-plane displacements to at least one process tool via at least one of a feed forward loop or a feedback loop to improve performance of one or more fabrication processes~~;~~.

~~wherein at least one of the at least the first characterization process or the at least the additional characterization process comprises at least one of one or more film property characterization processes or one or more intensity spectra characterization processes.~~

~~18.~~ 16. The system in ~~Claim 17,~~claim 15, wherein the one or more sets of program instructions are further configured to cause the one or more processors to:

provide at least one of the film force or the one or more in-plane displacements to the one or more characterization sub-systems via at least one of the feed forward loop or the feedback loop to improve performance of the at least the first characterization process or the at least the additional characterization process.

~~19.~~ 17. A method, comprising:

performing ~~at least~~ a first wafer geometry characterization process via at least one interferometer tool of one or more characterization sub-systems prior to a first lithography process on a semiconductor wafer; performing at least one characterization process via at least one reflection-mode characterization tool of the one or more characterization sub-systems following the first lithography process and prior to at least one discrete backside film deposition process on ~~a semiconductor wafer;~~

the semiconductor wafer, wherein the at least one characterization process comprises a film property characterization process or an intensity spectra characterization process; performing at least an additional characterization process via at least one reflection-mode characterization tool of the one or more characterization sub-systems following the at least one discrete backside film deposition process on the semiconductor wafer~~;~~

and prior to a second lithography process, wherein the at least the additional characterization process comprises a film property characterization process or an intensity spectra characterization process; perform a second wafer geometry characterization process via at least one interferometer tool of the one or more

characterization sub-systems prior to the second lithography process on the semiconductor wafer; determining at least one of a film force or one or more in-plane displacements for at least one discrete backside film deposited on the semiconductor wafer via the at least one discrete backside film deposition process based on the at least the first wafer geometry characterization process ~~and the~~ , the at least one characterization process, the at least the additional characterization process, and the second wafer geometry characterization process; and

providing at least one of the film force or the one or more in-plane displacements to at least one process tool via at least one of a feed forward loop or a feedback loop to improve performance of one or more fabrication processes~~,~~.

~~wherein at least one of the at least the first characterization process or the at least the additional characterization process comprises at least one of one or more film property characterization processes or one or more intensity spectra characterization processes.~~

~~20.~~ 18. The method in ~~Claim 19,~~claim 17, wherein the one or more film property characterization processes are configured to characterize ~~at least one of~~ a thickness, a real component of an index of refraction, ~~or~~and a complex component of the index of refraction of the at least one discrete backside film deposited on the semiconductor wafer via the at least one discrete backside film deposition process.

~~21.~~ 19. The method in ~~Claim 19,~~claim 17, wherein the at least the first characterization process includes one or more semiconductor characterization processes performed prior to the at least one discrete backside film deposition process on the semiconductor wafer, wherein the at least the additional characterization process includes one or more semiconductor characterization processes performed following the at least one discrete backside film deposition process on the semiconductor wafer.

~~22.~~ 20. The method in ~~Claim 19,~~claim 17, wherein the at least the first characterization process includes one or more semiconductor characterization processes performed prior to the at least one discrete backside film deposition

process on the semiconductor wafer, wherein the at least the additional characterization process includes one or more semiconductor characterization processes performed following each discrete backside film deposition process of the at least one discrete backside film deposition process on the semiconductor wafer.

~~23.~~ 21. The method in ~~Claim 19,~~claim 17, wherein the semiconductor process further includes at least one discrete frontside film deposition process on the semiconductor wafer.

~~24.~~ 22. The method in ~~Claim 23,~~claim 21, wherein the at least one discrete frontside film deposition process includes one or more discrete frontside film deposition processes following the first lithography process and prior to the at least one discrete backside film process on the semiconductor wafer, wherein the at least one characterization process is performed following the one or more discrete frontside film deposition processes.

~~25.~~ 23. The method in ~~Claim 23,~~claim 21, wherein the at least one discrete frontside film deposition process includes one or more discrete frontside film deposition processes following the at least one discrete backside film process ~~on the semiconductor wafer~~and prior to the second lithography process on the semiconductor wafer, wherein the at least the additional characterization process is performed prior to the one or more discrete frontside film deposition processes.

~~26.~~ 24. The method in ~~Claim 19,~~claim 17, wherein the at least the first characterization process and the at least the additional characterization process ~~comprises~~further comprise one or more wafer geometry characterization processes on the semiconductor wafer~~.~~ performed via at least one interferometer tool of the one or more characterization sub-systems.

~~27.~~ 25. The method in ~~Claim 26,~~claim 24, wherein the semiconductor production process further includes one or more lithography processes on the semiconductor wafer.

~~28.~~ 26. The method in ~~Claim 27,~~claim 25, wherein the one or more lithography processes include a first lithography process prior to the at least one discrete backside film process on the semiconductor wafer.

~~29.~~ 27. The method in ~~Claim 28,~~claim 26, wherein the first characterization process includes one or more semiconductor characterization processes prior to the first lithography process on the semiconductor wafer.

~~30.~~ 28. The method in ~~Claim 29,~~claim 27, wherein the one or more lithography processes includes an additional lithography process following the at least one discrete backside film process on the semiconductor wafer.

~~31.~~ 29. The method in ~~Claim 30,~~claim 28, wherein the additional characterization process includes one or more semiconductor characterization processes prior to the additional lithography process on the semiconductor wafer.

~~32.~~ 30. The method in ~~Claim 31, further comprising:~~

~~performing the at least the first characterization process, including:~~

~~performing at least one of the one or more wafer geometry characterization processes prior to the first lithography process; and~~

~~performing at least one of the one or more film property characterization processes prior to the at least one discrete backside film deposition process; and~~

~~performing the at least the additional characterization process, including:~~

~~performing at least one of the one or more film property characterization processes following the at least one discrete backside film deposition process; and~~

~~performing at least one of the one or more wafer geometry characterization processes following the at least one discrete backside film deposition process and prior to the additional lithography process.~~

~~33. The method in Claim 31, further comprising:~~

performing the at least the first characterization process, including:

performing at least one of the one or more wafer geometry characterization processes prior to the first lithography process; and

performing at least one of the one or more intensity spectra characterization processes prior to the at least one discrete backside film deposition process; and

performing the at least the additional characterization process, including:

performing at least one of the one or more intensity spectra characterization processes following the at least one discrete backside film deposition process; and

performing at least one of the one or more wafer geometry characterization processes following the at least one discrete backside film deposition process and prior to the additional lithography process.

34. The method in Claim 31, further comprising:

performing the at least the first characterization process, including:

performing at least one of the one or more wafer geometry characterization processes prior to the first lithography process; and

performing the at least the additional characterization process, including:

performing at least one of the one or more film property characterization processes or the one or more intensity spectra characterization processes following the at least one discrete backside film deposition process; and

performing at least one of the one or more wafer geometry characterization processes following the at least one discrete backside film deposition process and prior to the additional lithography process.

35. The method in Claim 31, further comprising:

performing the at least the first characterization process, including:

performing at least one of the one or more film property characterization processes or the one or more intensity spectra characterization processes prior to the first lithography process,

performing the at least the additional characterization process, including:

performing at least one of the one or more film property characterization processes or the one or more intensity spectra characterization processes following the at least one discrete backside film deposition process and prior to the additional lithography process.

36. The method in Claim 27,claim 25, wherein the one or more of the at least one discrete frontside film deposition process, the at least one discrete backside film deposition process, or the at least one lithography process is performed via the at least one process tool.

37. 31. The method in Claim 19,claim 17, further comprising:

providing at least one of the film force or the one or more in-plane displacements to the one or more characterization sub-systems via at least one of the feed forward loop or the feedback loop to improve performance of the at least the first characterization process or the at least the additional characterization process.

38. 32. A system, comprising:

a controller, wherein the controller includes one or more processors and memory configured to store one or more sets of program instructions, wherein the one or more processors are configured to execute the one or more sets of program instructions, wherein the one or more sets of program instructions are configured to cause the one or more processors to:

perform at least a first pre-lithography characterization process via at least one reflection-mode characterization tool of one or more characterization sub-systems prior to a first lithography process on a semiconductor wafer; perform at least one characterization process via at least one reflection-mode characterization tool of the one or more characterization sub-systems following the first lithography process and prior to at least one discrete backside film deposition process on athe semiconductor wafer;

perform at least an additional characterization process via at least one reflection-mode characterization tool of the one or more characterization sub-systems following the at least one discrete backside film deposition process on the semiconductor wafer;

and prior to a second lithography process; perform a second pre-lithography characterization process via at least one reflection-mode characterization tool of the one or more characterization sub-systems prior to the second lithography process on the semiconductor wafer; determine at least one of a film force or one or more in-plane displacements for at least one discrete backside film deposited on the semiconductor wafer via the at least one discrete backside film deposition process based on the ~~at least the~~ first pre-lithography characterization process ~~and~~, the at least one characterization process, the at least the additional characterization process~~; and~~

, and the second pre-lithography characterization process; and provide at least one of the film force or the one or more in-plane displacements to at least one process tool via at least one of a feed forward loop or a feedback loop to improve performance of one or more fabrication processes,

wherein the ~~at least the~~ first pre-lithography characterization process ~~and~~, the at least one characterization process, the at least the additional characterization process ~~comprises one or more wafer geometry characterization processes.~~ , and the second pre-lithography characterization process comprise a film property characterization process or an intensity spectra characterization process.

~~39.~~ 33. A system, comprising:

~~a~~ one or more characterization sub-~~system~~systems; and

a controller, wherein the controller includes one or more processors and memory configured to store one or more sets of program instructions, wherein the one or more processors are configured to execute the one or more sets of program instructions, wherein the one or more sets of program instructions are configured to cause the one or more processors to:

perform ~~at least~~ a first pre-lithography characterization process via at least one ~~or more~~reflection-mode characterization ~~sub-systems~~tool of the one or more characterization sub-systems prior to a first lithography process on a semiconductor wafer; perform at least one characterization process via at least one reflection-mode characterization tool of the one or more characterization sub-systems following the first lithography process

and prior to at least one discrete backside film deposition process on ~~a~~the semiconductor wafer;

perform at least an additional characterization process via at least one reflection-mode characterization tool of the one or more characterization sub-systems following the at least one discrete backside film deposition process on the semiconductor wafer~~;~~

and prior to a second lithography process; perform a second pre-lithography characterization process via at least one reflection-mode characterization tool of the one or more characterization sub-systems prior to the second lithography process on the semiconductor wafer; determine at least one of a film force or one or more in-plane displacements for at least one discrete backside film deposited on the semiconductor wafer via the at least one discrete backside film deposition process based on the ~~at least the~~ first pre-lithography characterization process ~~and the~~, the at least one characterization process, the at least the additional characterization process, and the second pre-lithography characterization process; and

provide at least one of the film force or the one or more in-plane displacements to at least one process tool via at least one of a feed forward loop or a feedback loop to improve performance of one or more fabrication processes, wherein the first pre-lithography characterization process, the at least one characterization process, the at least the additional characterization process, and the second pre-lithography characterization process comprise a film property characterization process or an intensity spectra characterization process.

~~wherein the at least the first characterization process and the at least the additional characterization process comprises one or more wafer geometry characterization processes.~~

~~40.~~ 34. A method, comprising:

performing ~~at least~~ a first pre-lithography characterization process via at least one reflection-mode characterization tool of one or more characterization sub-systems prior to a first lithography process on a semiconductor wafer; performing at least one characterization process via at least one reflection-mode characterization tool of the one or more characterization sub-systems following the first lithography process and prior to at least one discrete backside film deposition process on ~~a~~the semiconductor wafer;

performing at least an additional characterization process via at least one reflection-mode characterization tool of the one or more characterization sub-systems following the at least one discrete backside film deposition process on the semiconductor wafer;

and prior to a second lithography process; performing a second pre-lithography characterization process via at least one reflection-mode characterization tool of the one or more characterization sub-systems prior to the second lithography process on the semiconductor wafer; determining at least one of a film force or one or more in-plane displacements for at least one discrete backside film deposited on the semiconductor wafer via the at least one discrete backside film deposition process based on the at least the first pre-lithography characterization process and the , the at least one characterization process, the at least the additional characterization process, and the second pre-lithography characterization process; and

providing at least one of the film force or the one or more in-plane displacements to at least one process tool via at least one of a feed forward loop or a feedback loop to improve performance of one or more fabrication processes, wherein the first pre-lithography characterization process and the second pre-lithography characterization process comprise a film property characterization process or an intensity spectra characterization process.

wherein the at least the first characterization process and the at least the additional characterization process comprises one or more wafer geometry characterization processes.