[00115] An example non-inhibited ALD cycle 444 is as follows. At 446, the non-inhibited ALD cycle 444 comprises introducing an oxide film precursor into the processing chamber. As described above with regard to the inhibited ALD cycle 422, suitable oxide film precursors for forming silicon-containing oxide films can include polysilanes, aminosilanes, halosilanes, siloxanes, and organosilanes. In other examples, the oxide film precursor can comprise a metal-containing precursor. Example metal-containing precursors are described above. Next, at step 448, the processing chamber is purged to remove excess oxide film precursor.

[00116] Continuing, at 450, the non-inhibited ALD cycle 444 comprises introducing an oxidant into the processing chamber. Any suitable oxidant that can react with the oxide film precursor to form an oxide film can be used. Suitable oxidants include O2, O3, H2O, and H2O2.

[00117] At 452, the non-inhibited ALD cycle 444 comprises, at step 452, reacting the oxide film precursor with the oxidant to form a layer of oxide film on the substrate. In examples that utilize PEALD, a plasma can be used to form reactive oxidant species that react with the film precursor. Where a liner is deposited in a first portion of a gap, oxide film formation is inhibited and/or prevented in the first portion of the gap. On the other hand, oxide film growth occurs in a second portion of the gap that has no liner. In other examples, an ALD cycle can be performed using TALD. In such examples, the reaction at step 452 is performed using thermal energy. The substrate also can be heated during a PEALD cycle. In some examples, a purge is performed at step 454 after reacting the oxide to complete the ALD cycle. In other examples, a purge can be omitted.

[00118] Continuing, at step 456, after optionally performing an inhibited ALD cycle 422 or a non-inhibited ALD cycle 444, method 400 comprises determining whether to perform another ALD cycle. If it is determined not to perform another ALD cycle, then the bottom-up oxide deposition cycle of method 400 ends. On the other hand, if it is determined to perform another ALD cycle, then method 400 comprises, at step 458, determining whether to perform an inhibited ALD cycle. If the next cycle is an inhibited ALD cycle, then method 400 comprises, at 460, optionally adsorbing additional inhibitor to the substrate (as described with reference to step 424). Then, method 400 returns to step 432. If the next cycle is a non-inhibited ALD cycle, then method 400 returns to 446.

CLAIMS:

1. A method for partially filling a gap in a substrate disposed in a processing chamber, the method comprising;

depositing a sub-conformal layer of silicon nitride in a first portion of the gap and not in a second portion of the gap, the first portion extending from a top of the gap to a selected depth within the gap, and the second portion extending from the selected depth to a bottom of the gap; and

performing a plurality of atomic layer deposition (ALD) cycles to deposit a silicon-containing oxide in the second portion of the gap, an ALD cycle of the plurality of ALD cycles comprising

exposing the substrate to a silicon-containing precursor to adsorb the silicon-containing precursor to a surface in the second portion of the gap, and

reacting the silicon-containing precursor with an oxidant to deposit the silicon-containing oxide on the surface in the second portion of the gap.

2. The method of claim 1, wherein an ALD cycle of the plurality of ALD cycles comprises exposing the substrate to an inhibitor under conditions configured to deposit the inhibitor into the gap such that a concentration of the inhibitor deposited at a first depth within the gap is greater than a concentration of the inhibitor deposited at a second depth within the gap, the second depth being within the second portion of the gap and the second depth being farther from the top of the gap than the first depth.

3. The method of claim 2, wherein exposing the substrate to the inhibitor comprises exposing the substrate to a halogen-containing inhibitor, the halogen-containing inhibitor comprising one or more of molecular fluorine, hydrogen fluoride, boron trifluoride, phosphorus trifluoride, nitrogen trifluoride, a chlorofluorocarbon, a fluorocarbon, a hydrofluorocarbon, a chalcogen fluoride, a chalcogen chloride, or an interhalogen.

4. The method of claim 1, further comprising removing the sub-conformal layer of silicon nitride from the first portion of the gap after depositing the silicon-containing oxide.

5. The method of claim 1, wherein depositing the sub-conformal layer of silicon nitride comprises exposing the substrate to one or more of a halosilane precursor or an aminosilane precursor, purging the processing chamber, and forming a plasma comprising reactive nitrogen species.

6. The method of claim 1, wherein the gap comprises a trench for forming a trench isolation region in a logic device.

7. A method for processing a substrate comprising a gap, the method comprising:

depositing a liner in a first portion of the gap, the first portion extending from a top of the gap to a selected depth within the gap, and not depositing the liner in a second portion of the gap that extends from the selected depth to a bottom of the gap; and

performing a plurality of atomic layer deposition (ALD) cycles to deposit a silicon-containing oxide in the second portion of the gap, an ALD cycle of the plurality of ALD cycles comprising exposing the substrate to an inhibitor under conditions configured to deposit the inhibitor into the gap such that a concentration of the inhibitor deposited at a first depth is greater than a concentration of the inhibitor deposited at a second depth within the gap, the second depth being within the second portion of the gap and the second depth being farther from the top of the gap than the first depth.

8. The method of claim 7, further comprising removing the liner from the first portion of the gap.

9. The method of claim 7, wherein depositing the liner comprises depositing a silicon nitride liner.

10. The method of claim 7, further comprising performing an ALD cycle of the plurality of ALD cycles that omits exposing the substrate to the inhibitor.

11. The method of claim 7, wherein the inhibitor comprises one or more of molecular fluorine, hydrogen fluoride, boron trifluoride, phosphorus trifluoride, nitrogen trifluoride, a chlorofluorocarbon, a fluorocarbon, a hydrofluorocarbon, a chalcogen fluoride, a chalcogen chloride, or an interhalogen.

12. A structure formed on a substrate in an integrated circuit manufacturing process, the structure comprising:

a gap;

a silicon nitride film disposed within a first portion of the gap, the first portion extending from an opening of the gap to a selected depth within the gap; and

an oxide film within the gap, the oxide film at least partially filling a second portion of the gap, the second portion of the gap extending from the selected depth to a bottom of the gap.

13. The structure of claim 12, wherein the structure is part of a three-dimensional memory structure.

14. The structure of claim 12, wherein the silicon nitride film comprises a thickness within a range of 3-100 Å.

15. The structure of claim 12, wherein the substrate comprises a stack of layers of silicon alternating with silicon germanium, a stack of layers of polysilicon alternating with silicon oxide, or a stack of layers of silicon nitride alternating with silicon oxide.