CLAIMS

What is claimed is:

1. A method for processing substrates in a chamber, the method comprising:

providing a semiconductor substrate having a feature to a chamber; and

depositing dielectric material in the feature on the semiconductor substrate by:

introducing a deposition precursor and a reactant to the chamber housing the semiconductor substrate to expose the semiconductor substrate to a plasma-free environment comprising the deposition precursor and the reactant and form the dielectric material, and

introducing a passivation gas to the chamber and igniting a passivation plasma in a passivation gas ambient.

2. The method of claim 1, further comprising, exposing the dielectric material to a densification plasma in the chamber generated in an inert gas ambient.

3. The method of claim 1, wherein depositing the dielectric material further comprises repeating temporally alternating between introducing the deposition precursor and the reactant in a plasma-free environment and introducing the passivation gas.

4. The method of claim 2, wherein depositing the dielectric material further comprises repeating temporally alternating between introducing the deposition precursor and the reactant in a plasma-free environment, introducing the passivation gas, and exposing the dielectric material to the densification plasma in the chamber generated in the inert gas ambient.

5. A method for processing substrates in a chamber, the method comprising:

providing a semiconductor substrate having a feature to a chamber; and

depositing dielectric material in the feature on the semiconductor substrate by:

introducing a deposition precursor and a reactant to the chamber housing the semiconductor substrate to expose the semiconductor substrate to a plasma-free environment comprising the deposition precursor and the reactant and form the dielectric material, and

exposing the dielectric material to a densification plasma in the chamber generated in an inert gas ambient.

6. The method of claim 5, further comprising, introducing a passivation gas to the chamber and igniting a passivation plasma.

7. The method of claim 5, wherein depositing the dielectric material further comprises repeating temporally alternating between introducing the deposition precursor and the reactant in a plasma-free environment and exposing the dielectric material to the densification plasma generated in the inert gas ambient.

8. An apparatus for processing a semiconductor substrate comprising a semiconductor material, the apparatus comprising:

one or more process chambers, wherein at least one process chamber comprises:

a showerhead;

a heated pedestal for heating the semiconductor substrate to a temperature of at least about 650°C;

a plasma generator capable of generating a plasma within the at least one process chamber;

one or more gas sources;

one or more gas inlets to deliver gas from the one or more gas sources to the one or more process chambers via the showerhead;

a controller having at least one processor and a memory, whereby the at least one processor and the memory are communicatively connected with one another, the at least one processor is at least operatively connected with flow-control hardware, and the memory stores computer-executable instructions for controlling the at least one processor to at least control the flow-control hardware by:

causing setting of temperature of the heated pedestal to less than about 650°C; and

causing introduction of the following operations in temporally separated pulses:

causing introduction of a deposition precursor and a reactant to the one or more process chambers via the showerhead; and

after causing stopping of the introduction of the deposition precursor and the reactant, causing generation of a plasma when an inert gas are introduced to the one or more process chambers.

9. The apparatus of claim 8, wherein the controller instructions for causing temporally separated pulses comprise instructions for causing generation of a second plasma when a passivation gas is introduced to the one or more process chambers.

10. The apparatus of any of claims 8 or 9, wherein at least one of causing introduction of the deposition precursor and the reactant and causing generation of the plasma is performed by fast switching.