CLAIMS

1. A method for processing substrates, the method comprising:

providing a semiconductor substrate, wherein the semiconductor substrate comprises a metal layer formed in a dielectric layer and a barrier layer between the metal layer and the dielectric layer, the metal layer having an exposed metal surface and the barrier layer having an exposed barrier surface;

selectively depositing graphene on the exposed metal surface;

after selectively depositing graphene on the exposed metal surface, selectively depositing an inhibitor layer on the exposed barrier surface; and

selectively depositing a dielectric material on the dielectric layer.

2. The method of claim 1, wherein the inhibitor layer is selectively deposited on the exposed barrier surface before the dielectric material is selectively deposited on the dielectric layer.

3. The method of claim 1, wherein the inhibitor layer is a dielectric material.

4. The method of claim 1, wherein the inhibitor layer is a material selected from the group consisting of amides, beta-diketonates, and halides.

5. The method of claim 1, wherein the inhibitor layer comprises molecules having a hydrocarbon group.

6. The method of claim 1, wherein the inhibitor layer is deposited using an organometallic deposition precursor.

7. The method of claim 1, wherein the inhibitor layer is deposited using reactants selected from the group consisting of alcohols and amides.

8. The method of any of claims 1-7, wherein the barrier layer comprises a metal nitride.

9. A semiconductor device comprising:

a first dielectric layer;

a barrier layer lining the first dielectric layer;

a first metal layer formed in the first dielectric layer on the barrier layer;

a selective graphene film selectively formed on a top surface of the first metal layer relative to the first dielectric layer;

a selective inhibitor layer selectively formed on a top surface of the barrier layer relative to the selective graphene film and the first dielectric layer; and

a selective dielectric layer selectively formed on a top surface of the first dielectric layer relative to the first metal layer and the barrier layer.

10. An apparatus for processing substrates, the apparatus comprising:

one or more process chambers, each process chamber comprising a chuck;

one or more gas inlets into the process chambers and associated flow-control hardware; and

a controller having at least one processor and a memory, wherein

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 the 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 to:

cause introduction of a hydrocarbon precursor to selectively deposit graphene on an exposed metal surface of a substrate;

cause introduction of an organometallic deposition precursor to selectively deposit an inhibitor layer on an exposed barrier surface of the substrate; and

cause introduction of a dielectric deposition precursor to selectively form a dielectric material on a dielectric layer on the substrate.

11. The apparatus of claim 10, wherein the controller further comprises instructions for:

causing exposure of the graphene to a non-direct plasma to modify a surface of the graphene to form a modified surface; and

causing deposition of a metal oxide on the modified surface of the graphene and the

dielectric material by a thermal-based deposition technique.

12. The apparatus of claim 11, wherein causing deposition of the metal oxide comprises causing deposition of aluminum oxide by atomic layer deposition (ALD).

13. The apparatus of claim 11, wherein the non-direct plasma generates radicals of hydrogen mixed with radicals of oxygen, ammonia, nitrogen, or combinations thereof.

14. The apparatus of claim 10, wherein the controller further comprises instructions for:

causing removing of the graphene; and

causing deposition of a metal oxide on the exposed metal surface and the dielectric material.

15. The apparatus of claim 10, wherein the controller further comprises instructions for:

causing removal of the graphene; and

causing deposition of a hermetic barrier on the exposed metal surface and the dielectric material.

16. The apparatus of claim 10, wherein causing the selectively depositing of the graphene on the exposed metal surface comprises:

causing flowing one or more hydrocarbon precursors into the one or more process chambers and towards a substrate;

causing generation of radicals of hydrogen in a remote plasma source from a hydrogen source gas; and

causing introduction of the radicals of hydrogen into the one or more process chambers and towards the substrate, wherein the radicals of hydrogen react with the one or more hydrocarbon precursors to deposit the graphene on the exposed metal surface.