CLAIMS

1. A method of processing a substrate, comprising:

(a) flowing a carbon-containing precursor and a carrier gas into a processing volume of a process chamber;

(b) generating a plasma in the processing volume by applying a first RF bias to a substrate support to deposit a first portion of a carbon film onto internal surfaces of the process chamber;

(c) terminating flow of the carbon-containing precursor while maintaining flow of the carrier gas to maintain the plasma within the processing volume;

(d) flowing a nitrogen-containing gas into the processing volume and ionizing the nitrogen-containing gas in the presence of the plasma;

(e) exposing the internal surfaces of the process chamber having the carbon film thereon to the ionized nitrogen-containing gas for a time period of 1% to 2% of the time for steps (a), (b), (d), and (e) and less than 3 seconds to form an ammonia terminated surface on the carbon film;

(f) terminating flow of the nitrogen-containing gas while maintaining the plasma; and

(g) reintroducing the carbon-containing precursor into the processing volume in the presence of the plasma to deposit a second portion of the carbon film.

2. The method of claim 1, wherein the substrate is maintained at a temperature within a range of 10 °C to 20 °C.

3. The method of claim 1, wherein the processing volume is maintained at a pressure within a range of 3 mTorr to 20 mTorr.

4. The method of claim 1, wherein a flow rate of the carbon-containing precursor is within a range of 30 sccm to 1000 sccm.

5. The method of claim 1, wherein the carbon-containing precursor is introduced for 30 seconds to 120 seconds

6. The method of claim 1, wherein the carbon film is deposited to a final total thickness of 1 micron and 3 microns.

7. The method of claim 1, wherein the carbon-containing precursor is acetylene.

8. A method of processing a substrate, comprising:

(a) flowing a carbon-containing precursor and a carrier gas into a processing volume of a process chamber having a substrate positioned therein;

(b) generating a plasma in the processing volume by applying a first RF bias to a substrate support to deposit a first portion of a carbon film onto the internal surfaces of the process chamber;

(c) terminating the flow of the carbon-containing precursor and the flow of the carrier gas;

(d) flowing ammonia into the processing volume and contacting the carbon film with the ammonia to form an ammonia terminated surface for a time period of 1% to 2% of a time for steps (a), (b), and (d);

(e) terminating the flow of the ammonia; and

(f) reintroducing the carbon-containing precursor and the carrier gas into the processing volume to deposit a second portion of the carbon film at the ammonia terminated surface.

9. The method of claim 8, wherein the ammonia is flowed into the processing volume for time of less than 3 seconds.

10. The method of claim 8, wherein the ammonia remains in a gaseous state.

11. The method of claim 8, wherein a flow rate of the carbon-containing precursor is within a range of 30 sccm to 1000 sccm.

12. The method of claim 8, wherein the carbon-containing precursor is introduced for 30 seconds to 120 seconds

13. The method of claim 8, wherein the ammonia is introduced for 0.5 seconds to 3 seconds.

14. The method of claim 8, wherein the carbon film is deposited to a final total thickness of 1 micron and 3 microns.

15. The method of claim 8, wherein the carbon-containing precursor is acetylene.

16. A method of processing a substrate, comprising:

flowing a carbon-containing precursor gas and a first carrier gas into a processing volume of a process chamber having a substrate positioned therein, wherein a ratio of the carbon-containing precursor gas to the first carrier gas is 2:1 to 1:2;

generating a plasma in the processing volume by applying a first RF bias to a substrate support to deposit a first portion of a carbon film onto the substrate, wherein the first portion of the carbon film has a thickness with a range of 100 Å to 500 Å; and

flowing the carbon-containing precursor gas and a second carrier gas into a processing volume to deposit a second portion of carbon film onto the substrate, wherein the ratio of the carbon-containing precursor gas to the second carrier gas is 1:5 to 1:10, and wherein the second portion of the carbon film is has a thickness with a range of 5 Å to 30 Å, and wherein a composition of the second carrier gas is different than a composition of the first carrier gas.

17. The method of claim 16, wherein the first carrier gas is helium and the second carrier gas is argon.

18. The method of claim 16, wherein the carbon-containing precursor gas is acetylene.

19. The method of claim 16, wherein the carbon film is a hardmask and is deposited to a final total thickness of 1 micron and 3 microns.