What is claimed is

1. A method for depositing Mo-containing films comprising:

(i) contacting a substrate with one or more of MoO_2Cl_2 and MoO_2Br_2 vapor in a deposition reactor;

(ii) purging any unreacted MoO_2Cl_2 or MoO_2Br_2 with inert gas;

(iii) contacting the substrate in the deposition reactor with one or more chalcogenide precursor of formula (i) R_1XR_2 or formula (ii) R_1XXR_2,

wherein

X = S, Se or Te, and

R_1 and R_2 are each independently one of hydrogen, an unsubstituted linear C_1-C_6 alkyl group, a linear C_1-C_6 alkyl group substituted with one or more halogen, a linear C_1-C_6 alkyl group substituted with an amino group, an unsubstituted branched C_3-C_6 alkyl group, a branched C_3-C_6 alkyl group substituted with one or more halogen, a branched C_3-C_6 alkyl group substituted with an amino group, an unsubstituted amine, a substituted amine, and $-Si(CH_3)_3$;

(iv) optionally purging of any unreacted chalcogenide precursor with inert gas; and

(v) optionally treating the substrate with one or more of H_2S gas and an H_2S plasma.

2. The method of claim 1, wherein the step of (i) contacting a substrate with one or more of MoO_2Cl_2 and MoO_2Br_2 vapor in a deposition reactor comprises pulsing the one or more of MoO_2Cl_2 and MoO_2Br_2 vapor from about 0.1 seconds to about 25 seconds.

3. The method of claim 1, wherein the step of (i) contacting a substrate with one or more of MoO_2Cl_2 and MoO_2Br_2 vapor in a deposition reactor comprises pulsing at an ampule temperature of from about 55 ^{O}C to about 300 ^{O}C.

4. The method of claim 1, wherein the step of (i) contacting a substrate with one or more of MoO_2Cl_2 and MoO_2Br_2 vapor in a deposition reactor comprises pulsing at a gas flow of about 5 sccm to about 3000 sccm.

5. The method of claim 1, wherein the one or more chalcogenide precursor comprises a precursor of formula (i) R_1XR_2 wherein X = S, Se or Te, and R_1 and R_2 are each independently one of hydrogen, methyl, ethyl, n-propyl, iso-propyl, n-butyl, sec-butyl, iso-butyl and tert-butyl.

6. The method of claim 1, wherein the one or more chalcogenide precursor comprises a precursor of formula (ii) R_1XXR_2 wherein X = S, Se or Te, and R_1 and R_2 are each independently one of hydrogen, methyl, ethyl, n-propyl, iso-propyl, n-butyl, sec-butyl, iso-butyl and tert-butyl.

7. The method of claim 1, wherein X is S.

8. The method of claim 1, wherein X is Se.

9. The method of claim 1, wherein X is Te.

10. The method of claim 1, wherein the one or more chalcogenide precursor comprises one or more of iBu_2S, iPr_2S, iPr_2Se, Et_2S_2, Et_2Se, tBuSH, H_2Se, H_2S, H_2Te, Et_2Te and iPr_2Te.

11. The method of claim 1, wherein the step of (iii) contacting the substrate in the deposition reactor with one or more chalcogenide precursor comprises pulsing the precursor from about 0.5 seconds to about 25 seconds.

12. The method of claim 1, wherein the step of (iii) contacting the substrate in the deposition reactor with one or more chalcogenide precursor comprises pulsing the precursor at a vapor pressure of from about 0.3 Torr to about 15,000 Torr.

13. The method of claim 1, wherein the step of (iii) contacting the substrate in the deposition reactor with one or more chalcogenide precursor comprises pulsing the precursor at a carrier gas flow from about 0 sccm to about 3000 sccm.

14. The method of claim 1, wherein the step of (v) treating the substrate with one or more of H_2S gas and an H_2S plasma comprises treating with H_2S plasma wherein the H_2S plasma is directly generated in the reactor.

15. The method of claim 1, wherein the step of (v) treating the substrate with one or more of H_2S gas and an H_2S plasma comprises treating with H_2S plasma wherein the H_2S plasma is generated outside of the reactor and then supplied into the reactor.

16. The method of claim 1, wherein the substrate comprises one or more of aluminum oxide (Al_2O_3), aluminum nitride (AlN), silicon oxide (SiO_2), silicon oxynitride, silicon nitride (Si_3N_4), zirconium oxide (ZrO_2) and hafnium oxide (HfO_2).

17. The method of claim 1, wherein the reactor pressure is between about 0.1 to about 100 Torr.

18. A molybdenum-containing film deposited by the process of any of claims 1-17.

19. The method of claim 1, wherein the step of (i) contacting a substrate with one or more of MoO_2Cl_2 and MoO_2Br_2 comprises contacting the substrate with MoO_2Cl_2.

20. The method of claim 1, wherein the step of (i) contacting a substrate with one or more of MoO_2Cl_2 and MoO_2Br_2 comprises contacting the substrate with MoO_2Br_2.