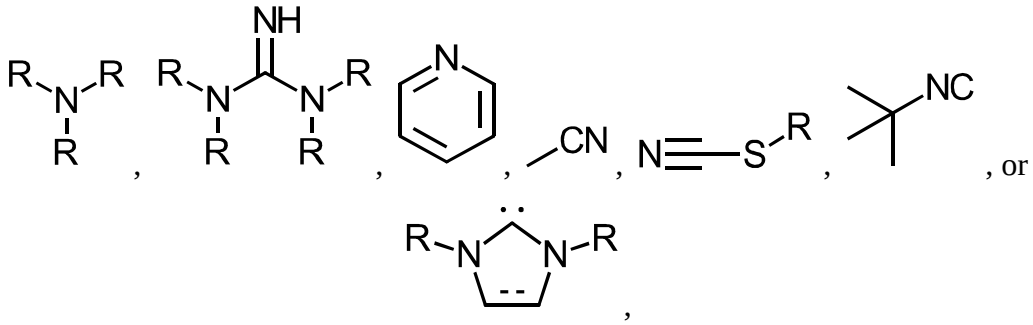
CLAIMS

1. A metal coordination complex comprising molybdenum(0), one arene ligand having a general formula of $C_6R_6$, the arene ligand is substituted with one or more alkyl group, and one or more neutral ligands, each neutral ligand coordinated by carbon or nitrogen, wherein each R is hydrogen, Me-, Et-, iPr-, or tBu-, , and the metal coordination complex has less than 5% halide and carbonyl groups on an atomic basis.

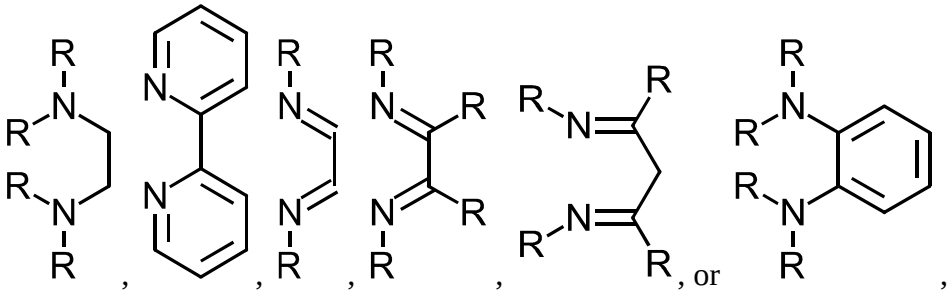
2. The metal coordination complex of claim 1 comprising one or more monodentate ligand.

3. The metal coordination complex of claim 2, wherein the one or more monodentate ligand is selected from one or more of:



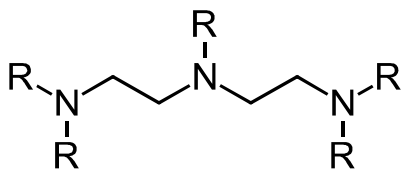
and wherein each R may be independently selected from Me-, Et-, iPr-, and tBu-.

4. The metal coordination complex of claim 1 comprising a bidentate ligand selected from one or more of:



and wherein each R may be independently selected from Me-, Et-, iPr-, and tBu-.

5. The metal coordination complex of claim 1 comprising a tridentate ligand selected from one or more of: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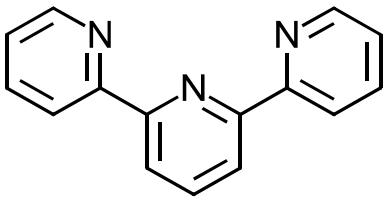
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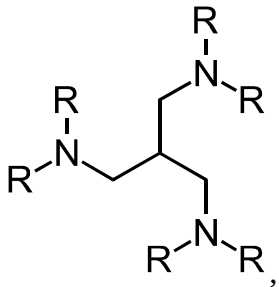
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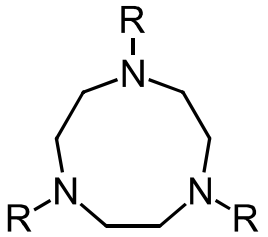
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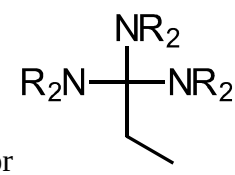

,

and wherein each R may be independently selected from Me-, Et-, iPr-, and tBu-.

6. A method of depositing a film, the method comprising:

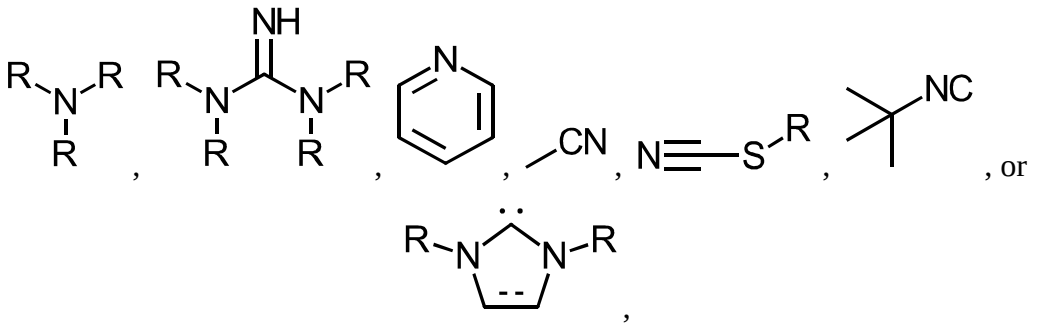
exposing a substrate to the molybdenum(0) precursor of claim 1; and

exposing the substrate to a reactant to react with the molybdenum(0) precursor to form a molybdenum film on the substrate.

7. The method of claim 6, wherein the arene ligand is substituted with one or more alkyl group.

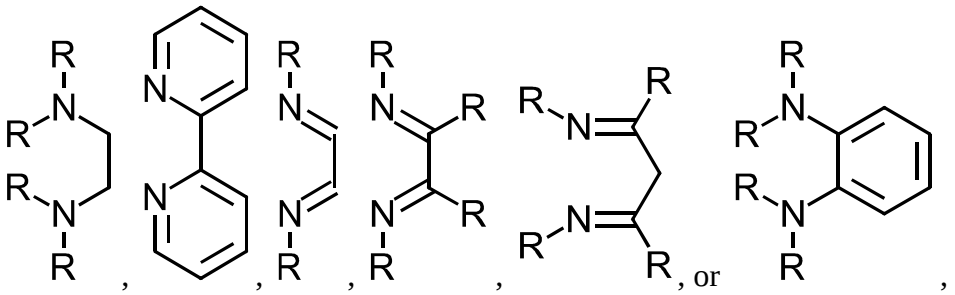
8. The method of claim 6, wherein the molybdenum(0) precursor comprises one or more monodentate ligand.

9. The method of claim 8, wherein the one or more monodentate ligand is selected from one or more of:



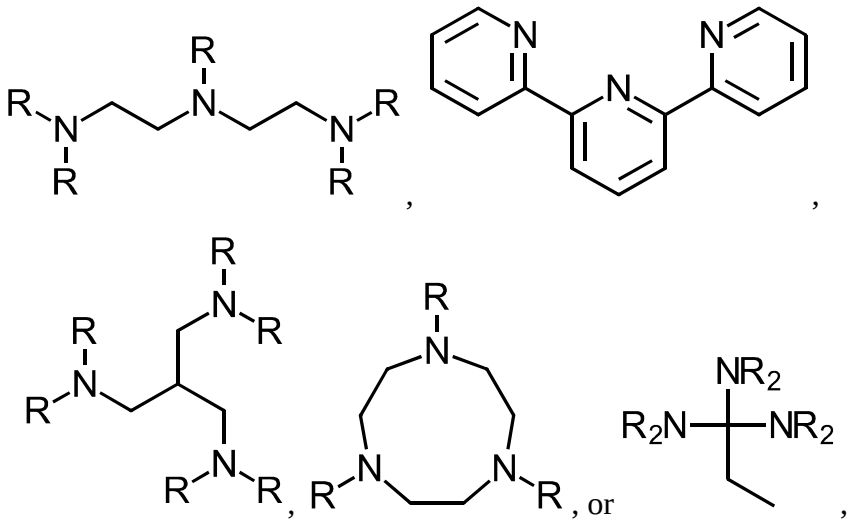
and wherein each R may be independently selected from Me-, Et-, iPr-, and tBu-.

10. The method of claim 6, wherein the molybdenum(0) precursor comprises a bidentate ligand selected from one or more of:



and wherein each R may be independently selected from Me-, Et-, iPr-, and tBu-.

11. The method of claim 6, wherein the molybdenum(0) precursor comprises a tridentate ligand selected from one or more of:



and wherein each R may be independently selected from Me-, Et-, iPr-, and tBu-.

12. The method of claim 6, wherein the reactant comprises one or more of one or more of an oxidizing agent and a reducing agent.

13. The method of claim 6, wherein the molybdenum film comprises one or more of a molybdenum metal (elemental Mo) film, a molybdenum oxide film, a molybdenum carbide film, a molybdenum silicide film, and a molybdenum nitride film.

14. The method of claim 6, wherein the substrate is exposed to the molybdenum(0) precursor and the reactant sequentially.

15. The method of claim 6, wherein the substrate is exposed to the molybdenum(0) precursor and the reactant simultaneously.

16. The method of claim 6, further comprising purging the substrate of the molybdenum(0) precursor prior to exposing the substrate to the reactant.

17. The method of claim 16, further comprising purging the substrate of the reactant and repeating the method to provide a molybdenum film having a thickness in a range of 0.3 nm to 100 nm.

18. A method of depositing a film, the method comprising:

forming a molybdenum-containing film in a process cycle comprising sequential exposure of a substrate to the molybdenum(0) precursor of claim 1, purge gas, reactant, and purge gas.