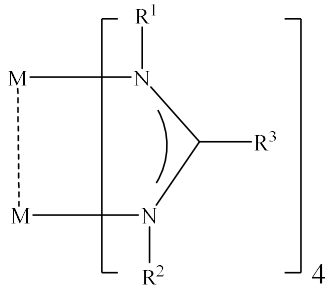
## CLAIMS

What is claimed is:

**1.** A precursor of formula I:




wherein

**(i)** M is one of chromium, molybdenum and tungsten; and

**(ii)** $R^1$ and $R^2$, are each independently selected from the group consisting of a Methyl group and an ethyl group; and

**(iii)** $R^3$ is a hydrogen.

**2.** The precursor of claim 1, wherein M is chromium.

**3.** The precursor of claim 1, wherein M is molybdenum.

**4.** The precursor of claim 1, wherein M is tungsten.

**5.** The precursor of claim 1, wherein **(ii)** $R^1$, $R^2$, $R^3$, $R^{3A}$ and $R^{3B}$ are each independently selected from H and an unsubstituted linear $C_1$-$C_6$ alkyl group.

**6.** The precursor of claim 1, wherein each of $R^1$ and $R^2$ is a methyl group.

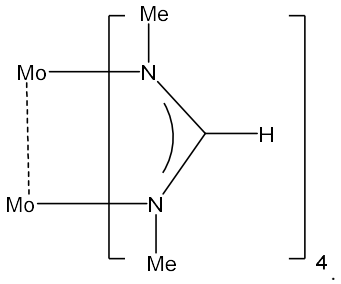
**7.** The precursor of claim 1, wherein one of $R^1$ and $R^2$ is a methyl group and the other of $R^1$ and $R^2$ is an ethyl group.

**8.** The precursor of claim 1, wherein one of $R^1$ and $R^2$ is a methyl group and the other of $R^1$ and $R^2$ is an ethyl group.

**9.** The precursor of claim 1, wherein $R^3$ is H.

**10.** The precursor of claim 1, wherein each of $R^{3A}$ and $R^{3B}$ is a methyl group.

**11.** The precursor of claim 1 having the formula:



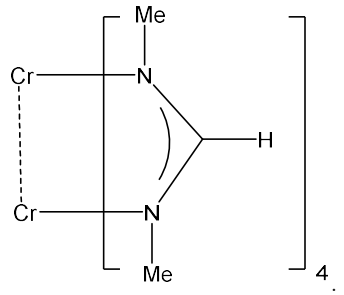

**12.** The precursor of claim 11 characterized by an x-ray powder diffraction pattern substantially in accordance with that shown in FIG. 14.\

**13.** The precursor of claim 11 characterized by an x-ray powder diffraction pattern comprising four or more 2θ values selected from the group consisting of:

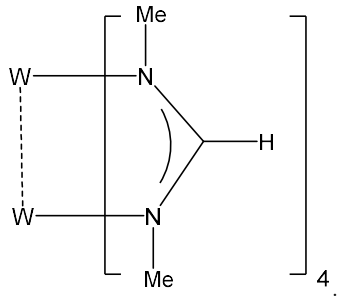
| **Peak No.** | **2 Theta (degree ±0.2)** |
|---|---|
| 1 | 11.16±0.2 |
| 2 | 11.98±0.2 |
| 3 | 13.00±0.2 |
| 4 | 13.98±0.2 |
| 5 | 16.64±0.2 |
| 6 | 18.52±0.2 |
| 7 | 18.72±0.2 |
| 8 | 20.54±0.2 |
| 9 | 21.34±0.2 |
| 10 | 26.06±0.2 |
| 11 | 26.44±0.2 |
| 12 | 26.88±0.2 |
| 13 | 27.54±0.2 |
| 14 | 28.82±0.2 |
| 15 | 33.64±0.2 |
| 16 | 33.98±0.2 |
| 17 | 37.34±0.2 |
| 18 | 37.78±0.2 |

**14.** The precursor of claim 11 characterized by an x-ray powder diffraction pattern having characteristic peaks at 11.16±0.2, 11.98±0.2, 13.00±0.2, 13.98±0.2 and 16.64±0.2 degrees 2θ.

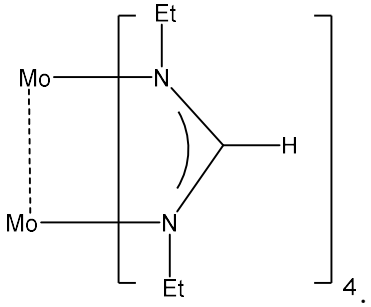
**15.** The precursor of claim 1 having the formula:




**16.** The precursor of claim 1 having the formula:




**17.** The precursor of claim 1 having the formula:



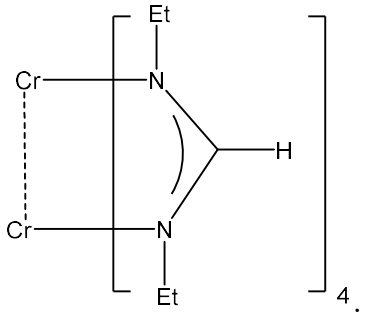

**18.** The precursor of claim 17 characterized by an x-ray powder diffraction pattern substantially in accordance with that shown in FIG. 15.

**19.** The precursor of claim 17 characterized by an x-ray powder diffraction pattern comprising four or more 2θ values selected from the group consisting of:

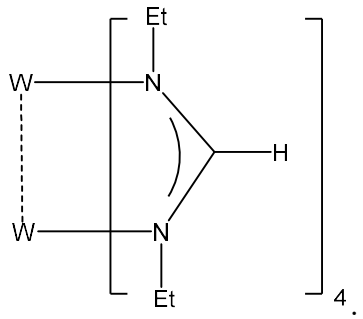
| **Peak No.** | **2 Theta (degree ± 0.2)** |
|---|---|
| 1 | 7.36±0.2 |
| 2 | 10.78±0.2 |
| 3 | 11.36±0.2 |
| 4 | 11.62±0.2 |
| 5 | 11.86±0.2 |
| 6 | 13.6±0.2 |
| 7 | 14.84±0.2 |
| 8 | 17.18±0.2 |
| 9 | 17.56±0.2 |
| 10 | 20.78±0.2 |
| 11 | 22±0.2 |
| 12 | 23.14±0.2 |
| 13 | 25.14±0.2 |
| 14 | 26.2±0.2 |
| 15 | 31.9±0.2 |
| 16 | 32.86±0.2 |
| 17 | 33.4±0.2 |

**20.** The precursor of claim 17 characterized by an x-ray powder diffraction pattern having characteristic peaks at 10.78±0.2, 11.36±0.2, 11.62±0.2, 11.86±0.2 and 13.6±0.2 degrees 2θ.

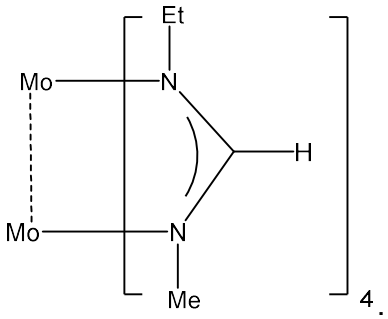
**21.** The precursor of claim 1 having the formula:



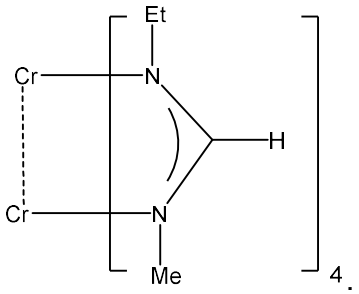
**22.** The precursor of claim 1 having the formula:



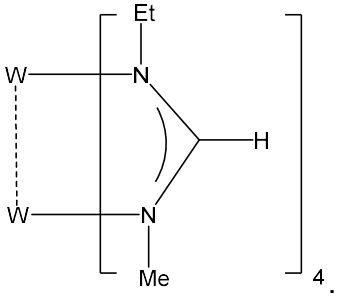

**23.** The precursor of claim 1 having the formula:



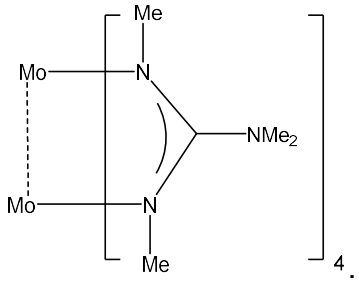

**24.** The precursor of claim 1 having the formula:



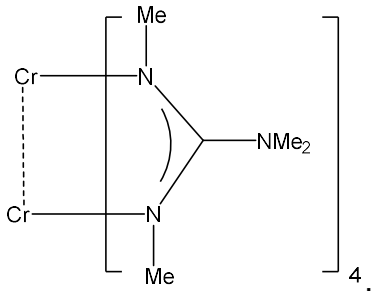

**25.** The precursor of claim 1 having the formula:



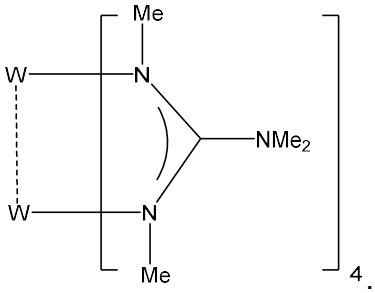
**26.** The precursor of claim 1 having the formula:




**27.** The precursor of claim 1 having the formula:




**28.** The precursor of claim 1 having the formula:




**29.** A method for forming a transition metal-containing film on at least one surface of a substrate comprising:

**a.** providing the at least one surface of the substrate in a reaction vessel;

**b.** forming a transition metal-containing film on the at least one surface by a thermal deposition process chosen from a chemical vapor deposition (CVD) process and an atomic layer deposition (ALD) process using one or more precursors of claim 1 as a metal source compound for the deposition process.