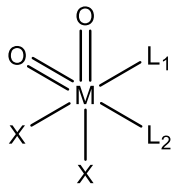
Claims

1. A process for forming a material on a substrate, comprising contacting the substrate with a compound of the Formula (I)



(I),

wherein M is chosen from molybdenum, chromium, and tungsten, X is chosen from fluoro, chloro, bromo, and iodo, and each L_1 and L_2 are the same or different and constitute:

(i) a monodentate hydrocarbyl ligand coordinated with M, or

(ii) are taken together to form a bidentate hydrocarbyl ligand coordinated with M; and depositing the molybdenum, chromium, or tungsten-containing material onto the substrate under vapor deposition conditions.

2. The process of claim 1, wherein the hydrocarbyl ligand further comprises at least one oxygen, sulfur, or nitrogen atom.

3. The process of claim 1, wherein L_1 and L_2 are chosen independently and comprise monodentate ligands or are taken together to form bidentate ligands and are chosen from diamines, triamines and glycols.

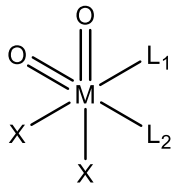
4. The process of claim 1, wherein L_1 and L_2 are chosen independently and comprise monodentate ligands or are taken together to form bidentate ligands and are chosen from t-butyl nitrile, toluene, tetrahyrofuran, and acetonitrile, and such groups optionally substituted by one or more groups chosen from halo, cyano, nitro, C_1-C_6 alky, C_1-C_6 alkoxy, tetrahydrofuran, C_1-C_6 alkoxycarbonyl, and phenyl;1,2-dimethoxyethane; 1,2-diethoxyethane; 1,2-dimethoxypropane; N,N-dimethylacetamide; N,N-dimethylformamide; N,N-dimethylcyanoacetamide; N,N,N',N'-tetramethylethylenediamine, ethylenediamine, hexaethylene diamine, diethylene triamine, and diethylenetriamine; dimethylsulfoxide; and

ethylene glycol, propylene glycol, 1,2-propanediol, 1,3-propanediol, 1,4-butanediol, 1,5-pentanediol, and 1,6-hexanediol.

5. The process of claim 1, wherein L_1 and L_2 are taken together to form a bidentate ligand chosen from ethylene glycol, propylene glycol, 1,2-propanediol, 1,3-propanediol, 1,4-butanediol, 1,5-pentanediol, 1,6-hexanediol, N,N,N',N'-tetramethylethylenediamine, ethylenediamine, and diethylenetriamine.

6. The process of claim 1, wherein M is molybdenum and L_1 and L_2 are 1,2-dimethoxyethane, tetrahydrofuran, or acetonitrile.

7. A compound of Formula (I)



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wherein M is chosen from molybdenum, chromium, and tungsten, X is chosen from fluoro, chloro, bromo, and iodo, and each L_1 and L_2 are the same or different and constitute:

(i) a monodentate hydrocarbyl ligand coordinated with M, or

(ii) are taken together to form a bidentate hydrocarbyl ligand coordinated with M; wherein Formula (I) is in solid or liquid form.

8. The compound of claim 1, wherein the hydrocarbyl ligand further comprises at least one oxygen, sulfur, or nitrogen atom.

9. The compound of claim 7, wherein the compound of Formula (I) possesses less than about 3 weight percent impurities.

10. The compound of claim 7, wherein the compound of Formula (I) is in crystalline form.

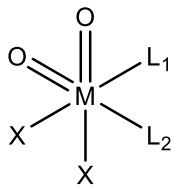
11. The compound of claim 7, wherein L_1 and L_2 are acetonitrile.

12. A compound of claim 10, having the formula $MoO_2Cl_2(CH_3CN)_2$ in crystalline form, and having less than 1% impurities by weight.

13. A compound of claim 10 having the formula $WO_2Cl_2(CH_3CN)_2$ in crystalline form, and having less than 1% impurities by weight.

14. A compound of claim 10 having the formula MoO_2Cl_2(tetrahydrofuran)$_2$ in crystalline form, and having less than 1% impurities by weight.

15. A process for preparing compounds of the Formula (I)



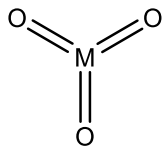
(I),

wherein M is chosen from molybdenum, chromium, and tungsten, X is chosen from fluoro, chloro, bromo, and iodo, and each L_1 and L_2 are the same or different and constitute:

(i) a monodentate hydrocarbyl ligand coordinated with M, or

(ii) are taken together to form a bidentate hydrocarbyl ligand coordinated with M; which comprises:

(A) contacting a compound of the formula



with (a) water containing about 0.1% (w/w) to about 48% (w/w) of a compound of the formula HX, and (b) a compound of the formula L_1 and/or L_2; followed by

(B) isolation of the compound of Formula (I) as a solid or liquid.