NANO3D SYSTEMS LLC
1110 NE Circle Blvd., ATAMI/Bldg. 11, Corvallis, Oregon 97330
T 503-927-4766| F 541-758-9320| https://nano3dsystems.com

NANO3D SYSTEMS, LLC formulates, markets and sells specialty chemicals for metal deposition including Electroplating (EP), Electroless Plating (ELP), Atomic Layer Deposition (ALD) and Chemical Vapor Deposition (CVD). Our products are used for research and development as well as commercial scale applications, especially in microelectronic, transportation and chemical industries. We also provide custom formulations of plating solutions, precursor synthesis, micro-fabrication and characterization services. For more information, visit NANO3D SYSTEMS LLC at https://nano3dsystems.com.

ALD & CVD precursors are presented in this brochure (sorted by elements) and include precursors for Iridium (**Ir**), Palladium (**Pd**), Platinum (**Pt**), Ruthenium (**Ru**), Rhodium (**Rh**), Gold (**Au**), Silver (**Ag**), Cobalt (**Co**), Nickel (**Ni**) and Copper (**Cu**) deposition.

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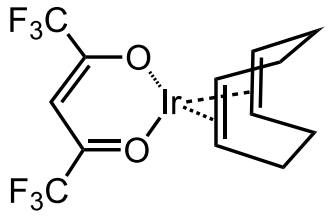
Ir(hfac)(cod) **CAS Number: 34801-95-1**

(1,1,1,5,5,5-hexafluoro-pentane-2,4-dionate)(1,5-cyclooctadiene)iridium(I), 98%



m.p. 117.5 °C, solid, air-stable, (subl. 80-95°C/0.5 Torr).

ln(*P*, atm.) = –11039/(*T*, K)+ 22.16, (*T* = 353-387 K). High-temperature mass-spectrometry data (in vacuum): vapors completely decompose at 300 -500°C (Ref. 1)

Technical Notes:
1. Useful catalyst for the ortho-deuteration of anilines, benzylamines, nitrogen heterocycles and functionalized aromatics. (Ref. 2-5)
2. Useful precursor for chemical vapor deposition of iridium containing films (Ref. 6-7) and nanoparticles (Ref. 8)

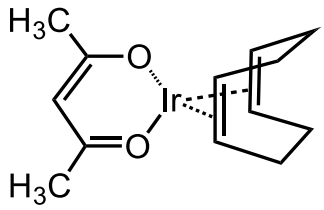
References:
1. Journal of Coordination Chemistry, 2016, 69(15), 228.
2. Journal of Labelled Compounds & Radiopharmaceuticals, 2005, 48, 75.
3. Journal of Labelled Compounds & Radiopharmaceuticals, 2003, 46, 1191.
4. Tetrahedron Lett., 2003, 44, 3959.
5. Tetrahedron Lett., 2000, 41, 2705.
6. Materials Research Society Symposium Proceedings, 1999, 541, 129.
7. Chemistry of Materials, 1998, 10, 2329.
8. Polyhedron, 2018, 155, 441.

Price for 1g **$297.44**

Other quantities are available upon request. Contact NANO3D SYSTEMS LLC for more info.

Ir(acac)(cod) **CAS Number: 12154-84-6**

(pentane-2,4-dionate)(1,5-cyclooctadiene)iridium(I), 98%



m.p. 155 °C, solid, air-stable.

ln(*P*, atm.) = –12736/(*T*, K)+ 22.83 (*T* = 363-423 K)(Ref. 1)

$\Delta_{melt}H = 21.3 \pm 0.5$ kJ·mol^{-1}, $\Delta_{melt}S = 49.6 \pm 0.6$ J·mol^{-1} K^{-1} (Ref. 1), high-temperature mass-spectrometry in vacuum: $T_{50\%}$(vapor decomposition) = 475 °C (Ref. 2).

Technical Notes:
1. Useful un-fluorinated precursor for chemical vapor deposition of iridium containing films (Ref. 4) and nanoparticles (Ref. 5)

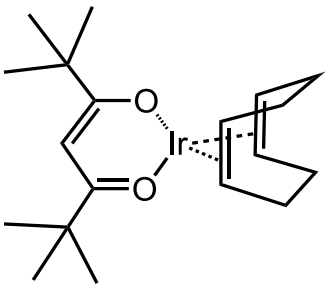
References:
1. Journal of Chemical Thermodynamics, 2019, 133, 194.
2. Journal of Coordination Chemistry, 2016, 69(15), 228.
3. Journal of Chemical Thermodynamics, 2019, 133, 194.
4. Thin Solid Films 1993, 241, 352.
5. Polyhedron, 2018, 155, 441.

Price for 1g **$279.21**

Other quantities are available upon request. Contact NANO3D SYSTEMS LLC for more info.

Ir(thd)(cod) **N/A**

(2,2,6,6-tetramethyl-3,5-heptanedionato) (1,5-cyclooctadiene)iridium(I), 98%



m.p. 169 °C, solid, air-stable, (subl. 100-140 °C/0.5 Torr).

ln(*P*, atm.) = –13055/(*T*, K)+ 22.74, (*T* = 373-438 K) (Ref. 1).

High-temperature mass-spectrometry in vacuum: stable without gas-reagents (35% vapor decomposition at 500°C) (Ref. 2).

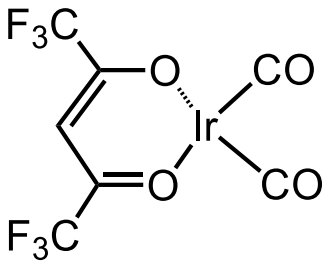
Technical Notes:
1. Useful precursor for chemical vapor deposition of iridium containing films (Ref. 2-3).

References:
1. Journal of Coordination Chemistry, 2016, 69(15), 228.
2. Chem. Mater. 1998, 10, 2329.
3. Appl. Surf. Sci. 2011, 257, 4204

Price for 1g **$370.76**
Other quantities are available upon request. Contact NANO3D SYSTEMS LLC for more info.

$Ir(hfac)(CO)_2$ **N/A**

(1,1,1,5,5,5-hexafluoro-pentane-2,4-dionate)dicarbonyl iridium(I), 98%



m.p. 90-93 °C, solid, air-stable.

The temperature range for the complete vaporization of $Ir(hfac)(CO)_2$ was determined to be 65-130 °C in helium flow (Ref. 1).

Technical Notes:

1. Extremely high volatile precursor for chemical vapor deposition of iridium with low carbon content (Ref. 1).

References:

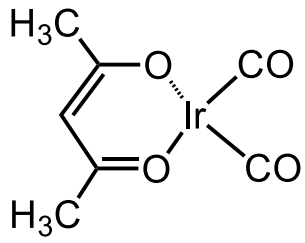
1. Journal of Structural Chemistry, 2015, 56(6), 1212.

Price for 1g **$392.49**

Other quantities are available upon request. Contact NANO3D SYSTEMS LLC for more info.

$Ir(acac)(CO)_2$ **CAS Number: 14023-80-4**

(pentane-2,4-dionate) dicarbonyl iridium(I), 98%



m.p. 145°C (dec.), solid, air-stable.

$\ln(P, \text{atm.}) = -11295/(T, \text{K}) + 22.40$, ($T = 306 - 333$K) (Ref. 1)

High-temperature mass-spectrometry: complete vapor decomposition patterns were collected in vacuum and in presence of oxygen and hydrogen (Ref. 2).

Technical Notes:

1. Conductive compound due to intermolecular metal-metal interactions (Ref. 3, 4).
2. Useful precursor for chemical vapor deposition of iridium containing films (Ref. 1, 5).

References:

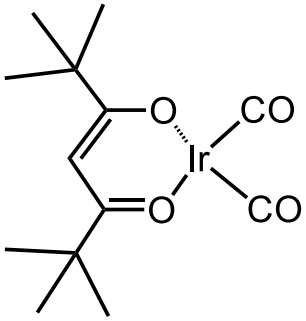
1. Journal of Structural Chemistry, 2012, 53(4), 715.
2. Journal of Thermal Analalysis and Calorimetry, 2009, 96(1), 261.
3. Journal of Structural Chemistry, 2009, 50(3), 595.
4. Journal of Organometallic Chemistry, 2017, 833, 88.
5. RSC Advances, 2015, 5(41), 32034.

Price for 1g **$235.04**

Other quantities are available upon request. Contact NANO3D SYSTEMS LLC for more info.

$Ir(thd)(CO)_2$ **N/A**

(2,2,6,6-tetramethyl-3,5-heptanedionate) dicarbonyl iridium(I), 98%



m.p. 158°C, solid, air-stable, (subl. 80-100 °C/0.5 Torr). The temperature range for the complete vaporization of $Ir(thd)(CO)_2$ was determined to be 125-200°C in helium flow.

Technical Notes:

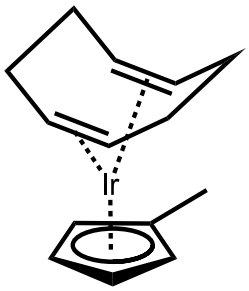
1. Novel perspective un-fluorinated precursor for chemical vapor deposition of iridium containing materials.

Price for 1g **$269.16**

Other quantities are available upon request. Contact NANO3D SYSTEMS LLC for more info.

Ir(Cp^{Me})(cod) **CAS Number: 132644-88-3**

(Methylcyclopentadienyl)(1, 5-cyclooctadiene) iridium, 98%



m.p. 38-40 °C, white solid, boiling point (subl. 100 °C/0.05 Torr)air-stable.

$\ln(P, \text{atm.}) = -10602/(T, \text{K})+19.43$, ($T$ = 373-433 K)

Technical Note:
1. The precursor for chemical vapor deposition of iridium containing films (Ref. 3)

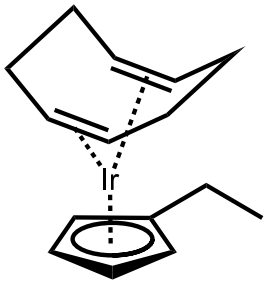
References:
1. J. Material Chem., 1991, 1(4), 551.
2. J. Vac. Sci. Tech. A, 2000, 18, 10.
3. Surface and Coating Technology, 2003, 163-164, 208.
4. J. of Material Research, 2001, 16(8), 2192.

Price for 1g **$365.41**

Other quantities are available upon request. Contact NANO3D SYSTEMS LLC for more info.

Ir(Cp^{Et})(cod) **N/A**

(Ethylcyclopentadienyl)(1, 5-cyclooctadiene) iridium, 98%



liquid, air-unstable.

ln(*P*, atm.) = –8327/(*T*, K)+13.13, (*T* = 305-354 K)

Technical Note:
1. The precursor for chemical vapor deposition of iridium containing films (Ref. 1, 2)

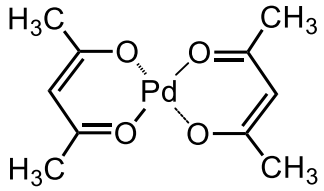
References:
1. Phys. Status Solidi C 2011, 8, 891.
2. J. Appl. Phys.2008, 103, 023517.

Price for 1g **$499.86**

Other quantities are available upon request. Contact NANO3D SYSTEMS LLC for more info.

$Pd(acac)_2$ **CAS Number: 14024-61-4**

Bis-(pentane-2,4-dionate)palladium, 99%



m.p. 210-250 C(dec.), solid, air-stable.

The temperature range for the sublimation of $Pd(acac)_2$, without undergoing thermal decomposition, was determined to be 100-160°C in the presence of inert gas helium (Ref. 1). The data of high-temperature mass-spectrometry (Ref. 2)

$\ln(P, \text{atm.}) = -15643/(T, \text{K})+28.30$, ($T$ = 373-433 K)

Technical Note:
1. Useful precursor for chemical vapor deposition of palladium containing films (Ref. 3)
2. Typical high-temperature organic solution phase protocol for the preparation of monodisperse CuPd alloy nanoparticles (NPs) (Ref. 4)
3. Catalyst in the decarboxylative cross-coupling of arylcarboxylic acids with aryl halides (Ref. 5)
4. Preparation of [(NHC)Pd(acac)L] (where L=Me, NHC = N-heterocyclic carbene) complexes. These complexes efficiently catalyze the Heck reaction of activated aryl bromides (Ref. 6)

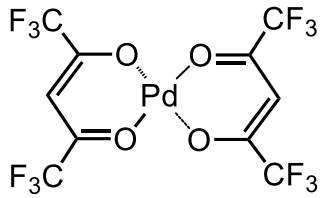
References:
1. Applied Physics 2001, 15(01), 23.
2. Le Journal de Physique IV, 1995, 5(C5), 205.
3. Desalination, 2002, 147(1–3), 425.
4. ACS Appl Mater Interfaces. 2015, 7(5), 3199.
5. J Am Chem Soc. 2007, 129(15), 4824.
6. Acc Chem Res. 2008, 41(11), 1440.

Price for 1g **$ 52.17**

Other quantities are available upon request. Contact NANO3D SYSTEMS LLC for more info.

$Pd(hfac)_2$ **CAS Number: 64916-48-9**

Bis-(1,1,1,5,5,5-hexafluoro-pentane-2,4-dionate)palladium, 99%



m.p. 99.6 C (DSC) solid, air-stable. (Ref.1)

The temperature range for the sublimation of $Pd(hfac)_2$, one-step mass loss (99%) in the range of 25-95°C under vacuum heating. (Ref. 2). The data for high-temperature mass-spectrometry are presented in (Ref. 3)

$\ln(P, \text{bar.}) = -11246/(T, \text{K})+25.31+\ln(760)$ (sub, $T = 318\text{-}368$ K)

$\ln(P, \text{bar.}) = -8160/(T, \text{K})+16.98+\ln(760)$ (evap, $T = 371\text{-}398$ K)

Technical Note:
Used in a redox transmetalation reaction to enhance CVD alloying technology for copper. Also used in the simultaneous etching of copper and deposition of palladium for applications in ultra large-scale integrated devices. (Ref. 4)

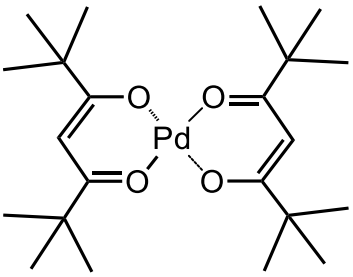
References:
1. Inorg. Chem. 1983, 22, 2281-2286
2. J Struct Chem, 2005, 46, 2, 320-327
3. Le Journal de Physique IV, 1995, 5(C5), 205.
4. JACS 1996, 118, 5977-5977

Price for 1g **$95.69**

Other quantities are available upon request. Contact NANO3D SYSTEMS LLC for more info.

$Pd(thd)_2$ **CAS Number: 15214-66-1**

Bis-(2,2,6,6-tetramethyl-3,5-heptanedionate)palladium, 99%



m.p. 239 C (DSC), solid, air-stable.

The sublimation temperature of $Pd(thd)_2$, without undergoing thermal decomposition, was determined to be 155-160°Cat P = 0.01 Torr (Ref. 1). The data for high-temperature mass-spectrometry are presented in (Ref. 2)

$\ln(P, \text{atm.}) = -15106/(T, \text{K})+27.88$, ($T$ = 343-401 K) (Ref. 3).

Technical Note:

Precursor for chemical vapor deposition of palladium containing films

References:

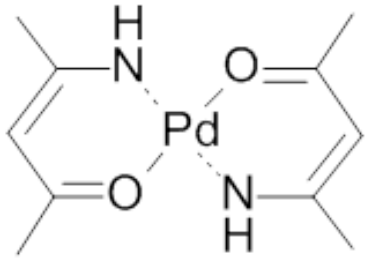
1. JTAC 2001, 63 (3), 1171-1182.
2. Le Journal de Physique IV, 1995, 5(C5), 205.
3. Koord. Khimiya (in Russia) 2000, 26(8), 576.

Price for 1g **$98.93**

Other quantities are available upon request. Contact NANO3D SYSTEMS LLC for more info.

$Pd(i\text{-}acac)_2$ **N/A**

Bis-(2-imino-pentane-4-onate)palladium, 99%



m.p. 245 C (dec.) solid, air-stable.

The temperature range for the sublimation of $Pd(i\text{-}acac)_2$, one-step mass loss (90%) in the range of 25-330°C in the presence of inert gas argon (Ref. 1).

$\ln(P, \text{atm.}) = -16992/(T, \text{K})+25.64$ (T = 453-513 K)

Technical Note:

Potential high volatile compound for chemical vapor deposition of palladium containing films

References:

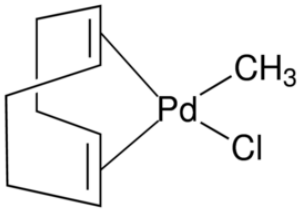
1. JTAC 2011, 103, 381-385

Price for 1g **$79.17**

Other quantities are available upon request. Contact NANO3D SYSTEMS LLC for more info.

$(CH_3)ClPd(cod)$ **CAS Number: 63936-85-6**

Chloro(1,5-cyclooctadiene)methylpalladium(II), 99%



m.p. 124-129 °C, solid, air-sensetive. Must ship overnight in dry ice.

Technical Note:

1. Catalyst for:
    - ***a.*** addition polymerization reactions
    - ***b.*** double carbonylation, cyclization
    - ***c.*** cyclometalation

References:

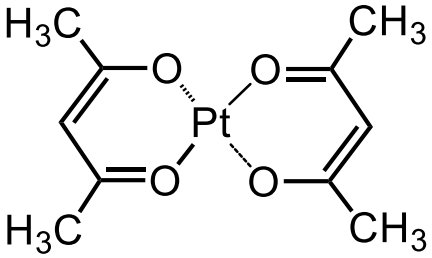
1. Journal of Molecular Catalysis A: Chemical 2014, 390, 76.

Price for 1g **$158.22**

Other quantities are available upon request. Contact NANO3D SYSTEMS LLC for more info.

$Pt(acac)_2$ **CAS Number: 15170-57-7**

Bis-(2,4-pentanedionate) platinum, 98%



m.p. 249-252 °C, pale yellow solid. The temperature range for the sublimation of $Pt(acac)_2$ is 120-175°C, one-step mass loss (80%) in the range of 25-250°C in the presence of inert gas helium (Ref. 1).

$\ln(P, \text{atm.}) = -18171/(T, \text{K})+27.43$, ($T$ = 397-438 K) (Ref.1);

298.15 K: $C_{p,m}^{\circ} = (292.8 \pm 0.5)$ J mol^{-1} K^{-1}, $\Delta_0^{298.15} S_m^{\circ} = (361.4 \pm 0.9)$ J mol^{-1} K^{-1}, $\Delta_0^{298.15} H_m^{\circ} = (51.35 \pm 0.09)$ kJ mol^{-1}, $\Phi_m^{\circ} = (189.2 \pm 0.7)$ J mol^{-1} K^{-} (Ref.2)

Technical Note:

1. Volatile platinum source for MOCVD applications (Ref.2, 3, 4)
2. Used with disodium iron tetracarbonyl to form FePt superlattice magnetic nanoparticles in high-boiling hydrocarbon solvents. (Ref.5)

References:

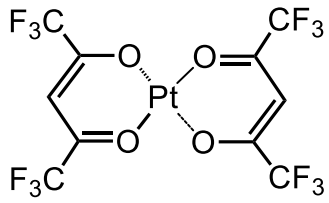
1. Zhurn. Struct. Khimii, 2005, 46(3), 507 (in Russian).
2. Journal of Thermal Analysis and Calorimetry 2016, 123(1), 899.
3. Russian Journal of Structural Chemistry 2015, 56(6), 1215.
4. Chem. Mater. 2014, 26, 786.
5. Front Chem. 2018, 16(6), 487.

Price for 1g **$94.37**

Other quantities are available upon request. Contact NANO3D SYSTEMS LLC for more info.

$Pt(hfac)_2$ **CAS Number: 65353-51-7**

Bis-(1,1,1,5,5,5-hexafluoro-2,4-pentanedionate) platinum, 98%



m.p. 144-145 °C, orange solid. The $Pt(hfac)_2$ is vaporized with one-step mass loss (90%) in the range of 25-200°C in the presence of inert gas helium (Ref. 1).

$\ln(P, \text{atm.}) = -10517/(T, \text{K})+27.43$, ($T = 297$-400 K) (Ref.1)

Technical Note:
1. Highly volatile platinum source for MOCVD applications (Ref.2, 3)

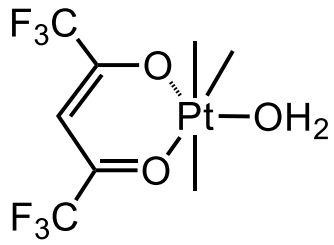
References:
1. Zhurn. Struct. Khimii, 2005, 46(3), 507 (in Russian).
2. J. Electrochem. Soc., 1998, 145(3), 1066.
3. Coordination Chemistry Reviews 2008, 252, 155.

Price for 1g **$345.68**

Other quantities are available upon request. Contact NANO3D SYSTEMS LLC for more info.

$(CH_3)_3Pt(hfac)H_2O$ **N/A**

(1,1,1,5,5,5-hexafluoro-2,4-pentanedionate) trimethyl platinum hydrate, 98%



m.p. 110-111 °C, light green solid. The $(CH_3)_3Pt(hfac)H_2O$ is vaporized with one-step mass loss (95%) in the range of 25-150°C in the presence of inert gas helium (Ref. 1).

$\ln(P, \text{atm.}) = -14753/(T, \text{K})+34.28$, ($T$ = 297-378 K) (Ref.1)

Technical Note:
1. Potential highly volatile platinum source for MOCVD applications (Ref.2)

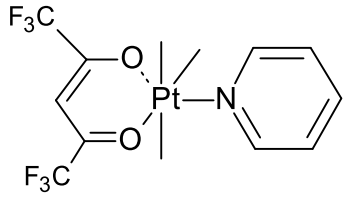
References:
1. Koord. Khim., 1983, 9(6), 845 (in Russian).
2. Polyhedron 2012, 40, 40.

Price for 1g **$398.22**

Other quantities are available upon request. Contact NANO3D SYSTEMS LLC for more info.

$(CH_3)_3Pt(hfac)Py$ **N/A**

(1,1,1,5,5,5-hexafluoro-2,4-pentanedionate) trimethyl platinum adduct with pyridine, 98%



m.p. 55-56°C, pale green solid. The $(CH_3)_3Pt(hfac)Py$ is vaporized with one-step mass loss (98%) in the range of 25-175°C in the presence of inert gas helium (Ref. 1).

evaporization $\ln(P, \text{atm.}) = -6799/(T, \text{K})+11.23$, ($T$ = 330-353 K) (Ref.2)

Technical Note:

1. Potential highly volatile platinum source for MOCVD applications (Ref.2)

References:

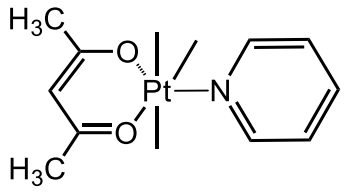
1. Koord. Khim., 1983, V.9, N6, P.845-850 (in Russian).
2. Applied Organometallic Chemistry 2017, 31(7), e3654.

Price for 1g **$399.83**

Other quantities are available upon request. Contact NANO3D SYSTEMS LLC for more info.

$(CH_3)_3Pt(acac)Py$ **N/A**

(pentane-2,4dionate) trimethyl platinum adduct with pyridine, 98%



m.p. 115-116 °C, pale green solid. The $(CH_3)_3Pt(acac)Py$ is vaporized with one-step mass loss (81%) in the range of 25-250°C in the presence of inert gas helium (Ref. 1).

$\ln(P, \text{atm.}) = -9699/(T, \text{K}) + 16.47$ (T = 393–414 K) (Ref.2)

Technical Note:
1. Volatile platinum source for MOCVD applications (Ref.2, 3, 4)

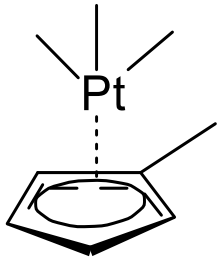
References:
1. Koord. Khim., 1983, V.9, N6, P.845-850 (in Russian).
2. Applied Organometallic Chemistry 2017, 31(7), e3654.
3. Phys. Status Solidi A 2015, 7, 212.

Price for 1g **$375.91**

Other quantities are available upon request. Contact NANO3D SYSTEMS LLC for more info.

$(CH_3)_3Pt(Cp^{Me})$ **CAS Number: 94442-22-5**

(Methylcyclopentadienyl) trimeylplatinum, 98%



m.p. 30-31 °C, white solid. Must ship overnight in dry ice. The $(CH_3)_3Pt(Cp^{Me})$ is vaporized with one-step mass loss (99%) in the range of 25-135°C in the presence of inert gas helium (Ref. 1).

$\ln(P, \text{atm.}) = -8690/(T, \text{K}) + 26.1$ ($T = 293–298$ K) (Ref.2)

Technical Note:

1. Volatile platinum source for MOCVD applications. These deposits find applications in microelectronics, catalysis, photonics and chemical sensing. (Ref. 1, 3)

References:

1. Coordination Chemistry Reviews 2008, 252, 155.
2. Chem. Vap. Depos. 11 (2005) 170.
3. Journal of Physical Chemistry C 2009, 113(6), 2487.

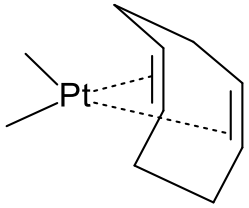
Price for 1g **$296.39**

Other quantities are available upon request. Contact NANO3D SYSTEMS LLC for more info.

NANO3D SYSTEMS LLC 1110 NE Circle Blvd., ATAMI/Bldg. 11, Corvallis, Oregon 97330
T 503-927-4766| F 541-758-9320| https://nano3dsystems.com

$(CH_3)_2Pt(cod)$ **CAS Number: 12266-92-1**

(1, 5-cyclooctadiene) dimethylpalladium, 98%



m.p. 105-106 C, colorless solid. The $(CH_3)_2Pt(cod)$ is vaporized with one-step mass loss (99%) in the range of 25-170°C in the presence of inert gas helium, 0.1 Torr at 100 °C (Ref. 1).

Technical Note:

1. Precursor for synthesis nbimetallic compounds (Ref. 2).
2. Volatile platinum source for MOCVD applications (Ref. 1,3). These deposits find applications in catalysis and chemical sensing. (Ref. 3, 4).

References:

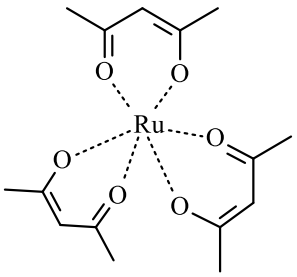
1. Coordination Chemistry Reviews 2008, 252, 155.
2. Inorg. Chem., 2009, 48 (13), 6124.
3. J. Mol. Catal. 1998, 135, 321.
4. Adv. Mater. 1992, 4, 375.

Price for 1g **$299.45**

Other quantities are available upon request. Contact NANO3D SYSTEMS LLC for more info.

$Ru(acac)_3$ **CAS Number: 14284-93-6**

Tris-(pentane-2,4-dionate) ruthenium, 98%



m.p. 240°C, red solid. The $Ru(acac)_3$ is vaporized one-step in the range of 25-250°C in the presence of inert gas helium (Ref. 1).

$\ln(P, \text{atm.}) = -15283/(T, \text{K}) + 25.57$ (T = 400–487 K) (Ref.1)

Technical Note:

1. Catalyzes the hydrogenation of dimethyl oxalate to ethylene glycol under mild conditions (Ref. 2).
2. Catalyst for the acetylation of phenols, alcohols, and amines under neat conditions (Ref. 3).
3. Volatile ruthenium source for MOCVD applications (Ref. 4).

References:

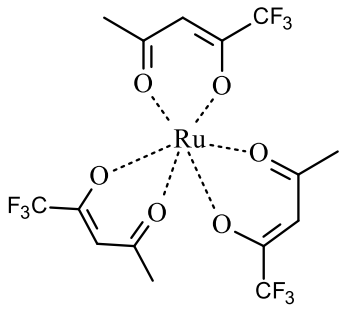
1. J. Therm. Analysis, 1996, 46, 1551.
2. Chemical Communications (Cambridge, England), 1997, 667.
3. Canadian Journal of Chemistry, 2007, 85(2), 148.
4. Chemical Vapor Deposition 2001, 7(3), 99.

Price for 1g **$65.96**

Other quantities are available upon request. Contact NANO3D SYSTEMS LLC for more info.

$Ru(tfac)_3$ **N/A**

Tris-(1,1,1,5,5,5-hexafluoro-2,4-pentanedionate) ruthenium, 98%



m.p. 147°C, red solid. The $Ru(tfac)_3$ is vaporized one-step in the range of 25-200°C in the presence of inert gas helium (Ref. 1).

$\ln(P, \text{atm.}) = -10830/(T, \text{K}) + 19.64$ ($T = 353–403$ K) (Ref.1)

Technical Note:
1. Potential highly volatile ruthenium source for MOCVD applications (Ref. 1).

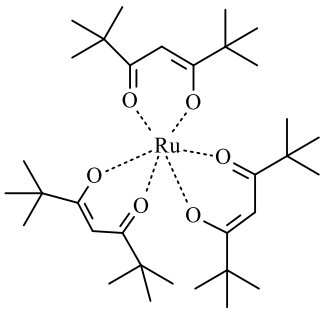
References:
1. J. Therm. Analysis, 1996, 46, 1551.

Price for 1g **$97.27**

Other quantities are available upon request. Contact NANO3D SYSTEMS LLC for more info.

$Ru(thd)_3$ **CAS Number: 38625-54-6**

Tris-(2,2,6,6-tetramethyl-3,5-heptanedionate) ruthenium, 98%



m.p. 210-213 °C, b. p. dec. 250°C (subl. 120°C/0.5 Torr), orange solid. The $Ru(thd)_3$ is vaporized one-step in the range of 25-275°C in the presence of inert gas helium (Ref. 1).

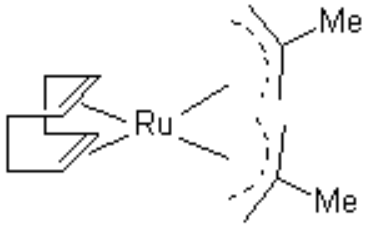
Technical Note:
1. Volatile ruthenium source for MOCVD/ALD applications (Ref. 2, 3).

References:
1. Koord. Khim., 1989, 15(1), 110 (in Russian).
2. Chemical Vapor Deposition 2004, 10(4), 215.
3. J. Mater. Res. 2004, 19, 3353.

Price for 1g **$228.95**
Other quantities are available upon request. Contact NANO3D SYSTEMS LLC for more info.

Ru(cod)(allyl-Me)$_2$ **CAS Number: 12289-94-0**

(1,5-Cyclooctadiene)ruthenium(II) dimethylallyl, 98%



m.p. 80-85 °C, brown solid, air sensitive. Must ship overnight in dry ice.

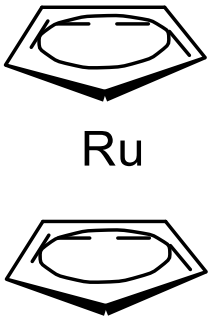
Technical Note:
1. Convenient precatalyst for Ru-catalyzed asymmetric hydrogenations (L2RuBr2 prepared in situ) (Ref. 1, 2).
2. β-ketoester reduction (Ref. 1, 3).
3. Anti-Markovnikov addition of amides to alkynes (Ref. 4).
4. Anti-Markovnikov hydroamination of vinylarenes (Ref. 5).
5. Catalyst for the addition of amides to alkynes (Ref. 6).

References:
1. Tetrahedron Lett.,1995, 36, 4801.
2. Acros Organics Acta, 1995, 1, 4. (review)
3. Angew. Chem. Int. Ed., 2005, 44, 4042.
4. J. Am. Chem. Soc., 2003, 125, 9570.
5. Advanced Synthesis and Catalysis, 2003, 345(1+2), 261.
6. J. Am. Chem. Soc., 2004, 126, 2702.

Price for 1g **$125.27**
Other quantities are available upon request. Contact NANO3D SYSTEMS LLC for more info.

$Ru(Cp)_2$ **CAS Number: 1287-13-4**

Bis-(cyclopentadienyl) ruthenium (Ruthenocene), 98%



m.p. 194-198 °C, light yellow. The $Ru(Cp)_2$ sublime in the range of 90-145 °C (Ref. 1).
$\log(P, \text{Pa.}) = -5249/(T, \text{K}) + 13.00$ ($T = 331–346$ K) (Ref.1)

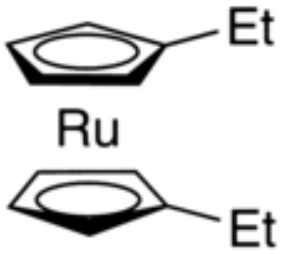
Technical Note:
1. Volatile ruthenium source for MOCVD/ALD applications (Ref. 2, 3).

References:
1. Materials 2010, 3, 1172.
2. J. Mater. Res. 2004, 19, 3353.
3. Chem. Vap. Deposition 2003, 9, 45.

Price for 1g **$98.16**
Other quantities are available upon request. Contact NANO3D SYSTEMS LLC for more info.

$Ru(^{Et}Cp)_2$ **CAS Number: 32992-96-4**

Bis-(ethylcyclopentadienyl) ruthenium, 98%



m.p. **6 C,** b.p. 100 °C/0.01 Torr, 1.3412 g/mL at 25 °C, must ship overnight in dry ice. (Ref.1)

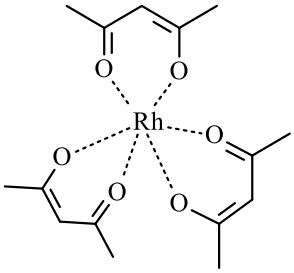
Technical Note:
1. Volatile ruthenium source for MOCVD/ALD applications (Ref. 2, 3).

References:
1. Materials 2010, 3, 1172.
2. Microelectron. Eng. 2008, 85, 39.
3 Thin Solid Films 2008, 516, 7345.

Price for 1g **$142.79**
Other quantities are available upon request. Contact NANO3D SYSTEMS LLC for more info.

$Rh(acac)_3$ **CAS Number: 14284-92-5**

Tris-(pentane-2,4-dionate) rhodium, 99%



m.p. 260 °C, yellow. The $Rh(acac)_3$ sublime in the range of 140-220 °C (Ref. 1).

ln (P, atm.) = –14633/(T, K) + 24.00 (T = 214–476 K) (Ref.1)

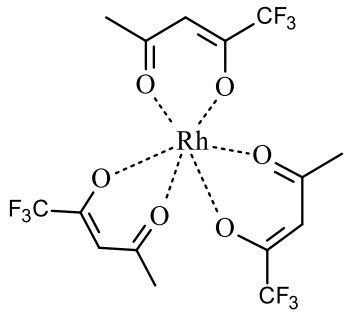
Technical Note:
1. Volatile rhodium source for MOCVD/ALD applications (Ref. 2, 3).
2. Catalyst for the hydrogenation of carboxylic acids when combined with group 6 or group 7 metal carbonyls (Ref. 4).

References:
1. J. Phys. IV France, 2001,.11(P.Pr3)609.
2. Electrochem. Soc. 2009, 156, D418.
3. Thin Solid Films 2013, 531, 243.
4. Tetrahedron Letters 1995, 36, 1059.

Price for 1g **$228.79**
Other quantities are available upon request. Contact NANO3D SYSTEMS LLC for more info.

$Rh(tfac)_3$ **N/A**

Tris-(1,1,1-trifluoro-2,4- pentanedionate) rhodium, 99%



m.p. 189 °C, -trans isomer, yellow. The $Rh(tfac)_3$ sublime in the range of 100-180 °C (Ref. 1, 2).

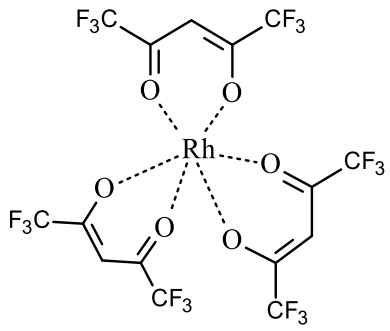
ln (*P*, atm.) = –11986/(*T*, K) + 21.39 (*T* = 373–400 K) (Ref.1)

Technical Note:
1. Potential high volatile rhodium source for MOCVD/ALD applications (Ref. 1).

References:
1. J. Phys. IV France, 2001,.11(P.Pr3)609.
2. Koord. Khim, 1985, 11(10), 1377 (in Russian).

Price for 1g **$285.48**
Other quantities are available upon request. Contact NANO3D SYSTEMS LLC for more info.

$Rh(hfac)_3$ **N/A**



Tris-(1,1,1,5,5,5-hexafluoro-2,4-pentanedionate) rhodium, 99%

m.p. 115 °C, yellow. The $Rh(hfac)_3$ sublime in the range of 50-100 °C (Ref. 1, 2).

sublimation ln (P, atm.) = –11383/(T, K) + 25.42 (T = 303–373 K) (Ref.1)

evoparization ln (P, atm.) = –7449/(T, K) + 20.70 (T = 393–423 K) (Ref.1)

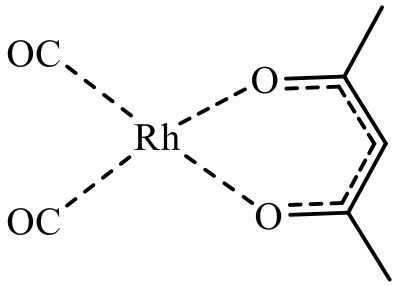
Technical Note:
1. Potential high volatile rhodium source for MOCVD/ALD applications (Ref. 1).

References:
1. J. Phys. IV France, 2001, 11(P.Pr3) 609.
2. Koord. Khim, 1985, 11(10), 1377 (in Russian).

Price for 1g **$365.72**
Other quantities are available upon request. Contact NANO3D SYSTEMS LLC for more info.

$Rh(acac)(CO)_2$ **CAS Number: 14874-82-9**

(Pentane-2,4-dionate) dicarbonyl rhodium, 99%



m.p. 154-156°C, yellow. The $Rh(acac)(CO)_2$ sublime in the range of 50-145°C, 1.7 Torr, 100 °C (Ref. 1).

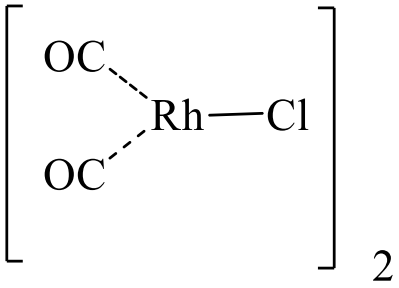
Technical Note:
1. Potential high volatile rhodium source for MOCVD/ALD applications (Ref. 2).
2. Employed in in situ formation of a fluorous-soluble hydroformylation catalyst of interest in molecular engineering (Ref. 3).
3. Precatalyst for hydroformylation of olefins (Ref. 4).
4. Precatalyst for silylformylation of olefins (Ref. 5).
5. Precatalyst for carbonylative silylcarbo-cyclization in the syntheses of isodomoic acids (Ref. 6).
6. Precatalyst for the conjugate addition of aryl- and alkenylboronic acids to enones (Ref. 7, 8).

References:
1. Coordination Chemistry Reviews 1998, 178–180, 1811.
2. Journal of Catalysis 1995,157(2), 294.
3. The journal of physical chemistry. A, 2008, 112(28), 6.
4. Synthesis, 2001, 1.
5. Org. Lett., 2009, 11, 2659.
6. J. Am. Chem. Soc., 1997, 119, 12416.
7. J. Am. Chem. Soc., 2009, 131, 14188.
8. Organometallics, 1997, 16, 4229.

Price for 1g **$241.65**
Other quantities are available upon request. Contact NANO3D SYSTEMS LLC for more info.

$[Rh(Cl)(CO)_2]_2$ **CAS Number: 14523-22-9**

Dicarbonyl rhodium chloride dimer, 97%



m.p. 124-125 °C, red solid, air sensitive.

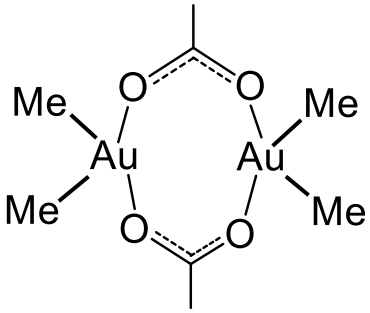
Technical Note:
1. Potential high volatile rhodium source for MOCVD/ALD applications

References:
1. J. Am. Chem. Soc., 2007, 129, 10060.
2. Chem. Asian. J., 2010, 5, 1555.
3. J. Am. Chem. Soc., 2008, 130, 7178.
4. Org. Lett., 2010, 12, 1332.
5. Org. Lett., 2010, 12, 2528.
6. J. Am. Chem. Soc., 2011, 133, 1690.
7. Org. Lett., 2011, 13, 134.
8. Chem. Commun., 2010, 46, 1059.
9. J. Am. Chem. Soc., 2011, 133, 447.
10. J. Am. Chem. Soc., 2010, 132, 4542.
11. Angew. Chem. Int. Ed., 2011, 50, 2144.

Price for 1g **$290.45**
Other quantities are available upon request. Contact NANO3D SYSTEMS LLC for more info.

$[(CH_3)_2AuCH_3COO]_2$ **N/A**

Acetate dimethylgold dimmer, 98%



m.p.95-96 C, dec., white solid, air-stable, light sensetive (Ref.1)

The vaporization of $[(CH_3)_2AuCH_3COO]_2$ is one-step mass loss (95%) in the range of 25-150°C in the presence of inert gas helium (Ref. 1). The data for high-temperature mass-spectrometry are presented in (Ref. 2)

$\ln(P, \text{atm.}) = -12142/(T, \text{K})+26.05$, ($T$ = 299-332 K)

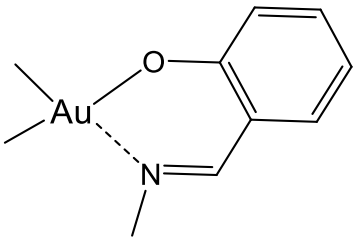
Technical Note:
1. Useful precursor for chemical vapor deposition of gold containing films (Ref. 3)

References:
1. J. Struct. Chem., 2007, 48, 282.
2. Journal of Thermal Analysis and Calorimetry, 2008, 92(3), 751.
3. Coordination Chemistry Reviews 2019, 380, 58.

Price for 1g **$1904.63**
Other quantities are available upon request. Contact NANO3D SYSTEMS LLC for more info.

$(CH_3)_2$AuSal=N-CH_3 **N/A**

Dimethyl(N-methylsalicylaldiminato)gold, 98%



m.p.101-103 C, light-yellow solid, air-stable, light sensetive (Ref.1)

The vaporization of $(CH_3)_2$AuSal=N-CH_3 is one-step mass loss (95%) in the range of 25-250°C in the presence of inert gas helium (Ref. 1). The data for high-temperature mass-spectrometry are presented in (Ref. 2)

$\ln(P, \text{atm.}) = -14909/(T, \text{K})+29.96$, ($T$ = 331-360 K)

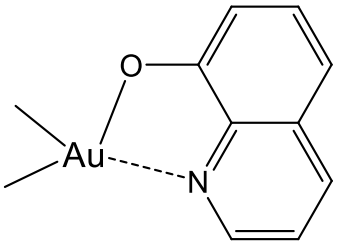
Technical Note:
1. Useful precursor for chemical vapor deposition of gold containing films (Ref. 2, 3, 4)

References:
1. J. Organomet. Chem., 1973, 61, 451.
2. Journal of Organometallic Chemistry 2008, 693, 2572.
3. Coordination Chemistry Reviews 2019, 380, 58.
4. Journal of Crystal Growth 2015, 414, 143.

Price for 1g **$1,997.13**
Other quantities are available upon request. Contact NANO3D SYSTEMS LLC for more info.

$(CH_3)_2AuC_9H_6NO$ **N/A**

Dimethyl(8-hydroxyquinolinato)gold(III), 98%



m.p.131-132 C, light-yellow solid, air-stable, light sensetive (Ref.1)

The vaporization of $(CH_3)_2AuC_9H_6NO$ is one-step mass loss (65%) in the range of 25-250°C in the presence of inert gas helium (Ref. 2).

$\ln(P, \text{atm.}) = -14584/(T, \text{K})+26.97$, ($T$ = 357-387 K)

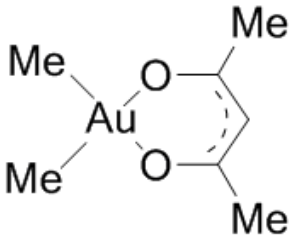
Technical Note:
1. Useful precursor for chemical vapor deposition of gold containing films (Ref. 3, 4)

References:
1. J. Organomet. Chem., 1968,14(2), 467.
2. Russian Journal of Coordination Chemistry, 2008, 34(3), 186.
3. Coordination Chemistry Reviews 2019, 380, 58.
4. Journal of Crystal Growth 2015, 414, 143.

Price for 1g **$1,998.54**
Other quantities are available upon request. Contact NANO3D SYSTEMS LLC for more info.

$[(CH_3)_2Au(acac)]$ **CAS Number: 14951-50-9**

Dimethyl-(pentane-2,4-dionate) gold, 98%



m.p. 76-76 C, white solid, light sensetive (Ref.1) . Must ship overnight in dry ice.

$\ln(P, \text{atm.}) = -11468/(T, \text{K})+22.44$, ($T$ = 297-312 K) (Ref.2)

Technical Note:
1. Highly volatile gold source for MOCVD applications (Ref.3)
2. Precursor for synthesis of gold nanoparticles. Au/ZrO_2 and Au/Al_2O_3 prepared in this way were extremely efficient catalysts for the aerobic oxidation of glucose. (Ref. 4).

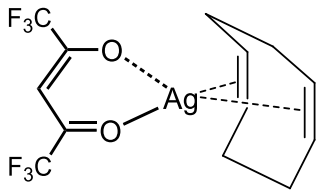
References:
1. Koord. Khim., 1980, 6(5), 720 (in Russian).
2. Russian Journal of Coordination Chemistry, 2006, 47, 473.
3. Coordination Chemistry Reviews 2019, 380, 58.
4. Angew. Chem. Int. Ed., 2008, 47, 9265.

Price for 1g **$1,950.98**

Other quantities are available upon request. Contact NANO3D SYSTEMS LLC for more info.

Ag(cod)(hfac) **CAS Number: 38892-25-0**

(1,5-Cyclooctadiene) (1,1,1,5,5,5-hexafluoro-2,4-pentanedionate) silver, 97%



m.p. (110 °C dec.) (Ref. 1), light sensitive. Dimer structure (Ref. 2).

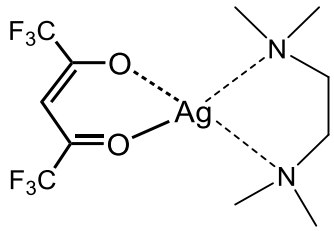
Technical Note:
1. High volatile silver source for MOCVD/ALD applications (Ref. 1, 3).
2. Precursor for synthesis silver nanoparticals (Ref.4).

References:
1. Advances in Polymer Technology, 2012, 31(3), 242.
2. Polyhedron, 1993, 12(14), 1785.
3. Scientific reports, 2016, 6, 20814.
4. Nanotechnol Russia 2010,5, 435.

Price for 1g **$51.35**
Other quantities are available upon request. Contact NANO3D SYSTEMS LLC for more info.

Ag(tmeda)(hfac) **N/A**

Tetramethylethylenediamine (1,1,1,5,5,5-hexafluoro-2,4-pentanedionate) silver, 97%



57 °C solid-solid phase transition, m.p. (110 °C dec.), light sensitive.

The vaporization of Ag(tmeda)(hfac) is one-step mass loss (66%) in the range of 50-250°C in the presence of inert gas helium, (subl. 70 °C/0.133 Pa) (Ref. 1).

Technical Note:
1. High volatile silver source for MOCVD/ALD applications (Ref. 1).

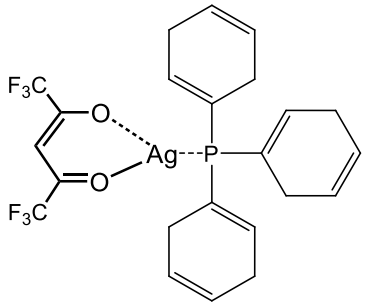
References:
1. Chemical Vapor Deposition 2004, 10(4), 207.

Price for 1g **$108.67**

Other quantities are available upon request. Contact NANO3D SYSTEMS LLC for more info.

$Ag(PPh_3)(hfac)$ **N/A**

Trisphenylphosphine(1,1,1,5,5,5-hexafluoro-2,4-pentanedionate) silver, 97%



sand solid, light sensitive. The $Ag(PPh_3)(hfac)$ is vaporized in the one step in the range 50-350°C(Ref. 1).

Technical Note:
1. High volatile silver source for MOCVD/ALD applications (Ref. 1).

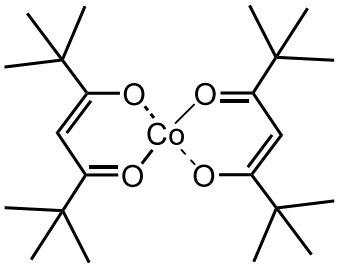
References:
1. J. Mater. Chem., 1999, 9, 1771.

Price for 1g **$104.39**

Other quantities are available upon request. Contact NANO3D SYSTEMS LLC for more info.

$Co(thd)_2$ **N/A**

Bis-(2,2,6,6-tetramethyl-3,5-heptanedionate)cobalt, 99%



m.p. 198°C (dec.), purple solid. The $Co(thd)_2$ sublime in the range of 50-175°C.

sublimation from DTA data ln (P, atm.) = –17208/(T, K) + 38.74 (T = 433 - 463 K) (Ref.1)

Technical Note:

1. Volatile cobalt source for MOCVD/ALD applications (Ref.2).
2. Catalyst for aerobic epoxidation and hydroperoxysilylation of unactivated alkenes (Ref.3).

References:

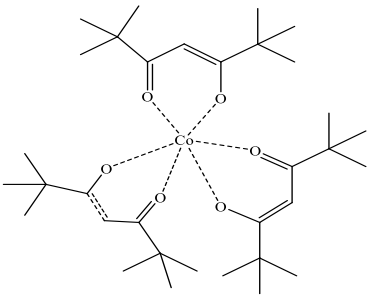
1. Adv. Mater. Opt. Electron. 2000, 10, 223.
2. Dalton Trans., 2016,45, 10730-10735
3. Tetrahedron Letters 2003, 44, 8135.

Price for 1g **$122.87**

Other quantities are available upon request. Contact NANO3D SYSTEMS LLC for more info.

$Co(thd)_3$ **CAS Number: 14877-41-9**

Tris-(2,2,6,6-tetramethyl-3,5-heptanedionate)cobalt, 99%



m.p. 254-256 °C, green solid. Polymorphism (Ref.1). The $Co(thd)_3$ sublime in the range of 100-160 °C. Complex decomposed to $Co(thd)_2$ during sublimation higher than 180 °C.

sublimation from DTA data ln (P, atm.) = –15884/(T, K) + 36.07 (T = 373 - 403 K) (Ref.2)

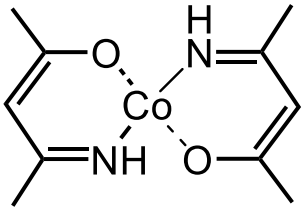
Technical Note:
1. Potential volatile cobalt source for MOCVD/ALD applications

References:
1. Zeitschrift für anorganische und allgemeine Chemie 2008,634(2), 247.
2. Adv. Mater. Opt. Electron. 2000, 10, 223.

Price for 1g **$67.45**
Other quantities are available upon request. Contact NANO3D SYSTEMS LLC for more info.

$Co(i\text{-}acac)_2$ **N/A**

Bis-(2-imino-pentane-4-onate)cobalt, 99%



m.p. 171-172 °C, b. p. 250 °C, orange solid. The $Co(i\text{-}acac)_2$ sublime in the range of 50-130°C, decomposed 140 °C.

ln (P, atm.) = –168224/(T, K) + 32.02 (T = 303 - 393 K)

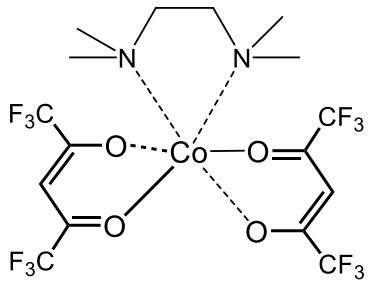
Technical Note:
1. Potential volatile cobalt source for MOCVD/ALD applications

References:
Unpublished results

Price for 1g **$105.59**
Other quantities are available upon request. Contact NANO3D SYSTEMS LLC for more info.

$Co(tmeda)(hfac)_2$ **N/A**

Tetramethylethylenediamine bis-(1,1,1,5,5,5- hexafluoro-2,4-pentanedionate)cobalt, 98%



m.p. 94-95 °C, orange solid. The $Co(tmeda)(hfac)_2$ is vaporized in the one step (mass loss 99%) in the range of 50-200 °C (Ref. 1)

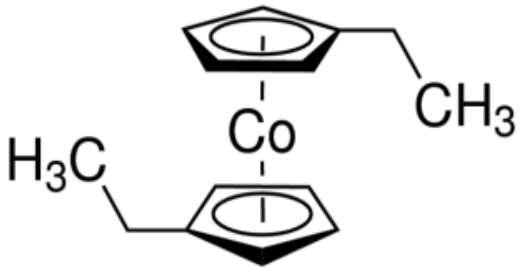
Technical Note:
1. Volatile cobalt source for MOCVD/ALD applications (Ref.1)

References:
1. Inorganic Chemistry 2009, 48(1), 82.

Price for 1g **$283.74**
Other quantities are available upon request. Contact NANO3D SYSTEMS LLC for more info.

$Co(^{Et}Cp)_2$ **CAS Number: 55940-05-1**

1,1'-Diethylcobaltocene, 98%



liquid, 1.516 g/mL at 25 °C, Must ship overnight in dry ice.

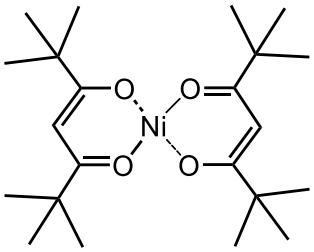
Technical Note:
1. Volatile cobalt source for MOCVD/ALD applications (Ref.1).
2. This metallocene compound may be encapsulated in single walled carbon nanotubes, resulting in a tailored carbon nano structure of specific electronic functionality (Ref.2).

References:
1. Chem. Mater., 2016, 28 (3), 700.
2. Nature Materials 2005,4(6), 481.

Price for 1g **$162.68**
Other quantities are available upon request. Contact NANO3D SYSTEMS LLC for more info.

$Ni(thd)_2$ **CAS Number: 14481-08-4**

Bis-(2,2,6,6-tetramethyl-3,5-heptanedionate)nickel, 99%



m.p. 219-223 °C, red solid. The $Ni(thd)_2$ sublime in the range of 50-175 °C.

ln (*P*, atm.) = –12527/(*T*, K) + 21.37 (*T* = 393 - 463 K) (Ref.1)

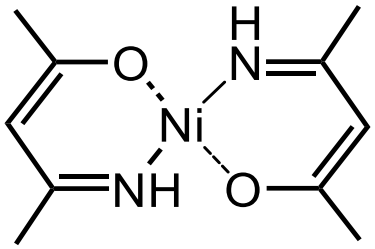
Technical Note:
1. Volatile nickel source for MOCVD/ALD applications (Ref.2, 3).

References:
1. Electrochem. Soc. Proc. 1997, 25, 89.
2. Chemical Vapor Deposition, 2009, 15(7-9), 186.
3. Journal of Crystal Growth, 2209, 311(16), 4082.

Price for 1g **$38.10**
Other quantities are available upon request. Contact NANO3D SYSTEMS LLC for more info.

$Ni(i\text{-}acac)_2$ **N/A**

Bis-(2-imino-pentane-4-onate)nickel, 99%



m.p. 240-241 °C, red solid. The $Ni(i\text{-}acac)_2$ sublime in the range of 50-130 °C, decomposed 140°C (Ref.1).

ln (*P*, atm.) = –12497/(*T*, K) + 21.35 (*T* = 447 - 516 K) (Ref.2).

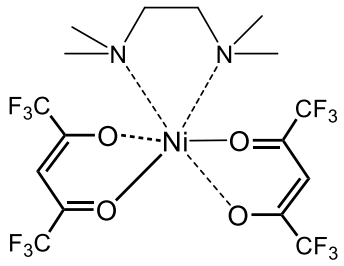
Technical Note:
1. Potential volatile nickel source for MOCVD/ALD applications

References:
1. Thermochim. Acta. 1980,38, 315.
2. Surface and Coatings Technology, 2013, 230, 290.

Price for 1g **$55.61**
Other quantities are available upon request. Contact NANO3D SYSTEMS LLC for more info.

$Ni(tmeda)(hfac)_2$ **N/A**

Tetramethylethylenediamine bis-(1,1,1,5,5,5- hexafluoro-2,4-pentanedionate)nickel, 98%



low m.p., green solid. The $Ni(tmeda)(hfac)_2$ is vaporized in the one step (mass loss 99%) (Ref. 1)

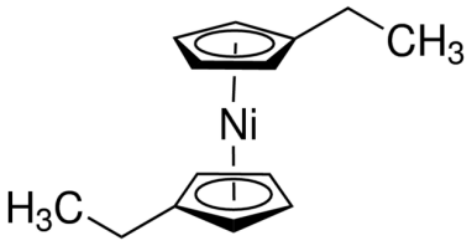
Technical Note:
1. Volatile nickel source for MOCVD/ALD applications (Ref.1)

References:
1. MRS Proceedings, 1995, 415, 93

Price for 1g **$132.87**
Other quantities are available upon request. Contact NANO3D SYSTEMS LLC for more info.

$Ni(^{Et}Cp)_2$ **CAS Number: 31886-51-8**

1,1'-Diethylnickelocene, 98%



green liquid, b.p. 90 °C, 1.137 g/mL at 25 °C, Must ship overnight in dry ice.

lnP = −5210/T +18.98 (*T* = 345 - 370 K) (Ref.1).

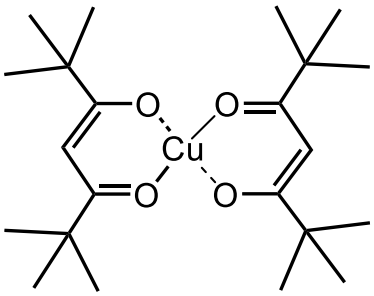
Technical Note:
1. Volatile nickel source for MOCVD/ALD applications (Ref.1).

References:
1. Journal of Nanoscience and Nanotechnology 2011, 11, 8259.

Price for 1g **$96.43**
Other quantities are available upon request. Contact NANO3D SYSTEMS LLC for more info.

$Cu(thd)_2$ **CAS Number: 14040-05-2**

Bis-(2,2,6,6-tetramethyl-3,5-heptanedionate)copper, 98%



m.p. 198 °C, violet solid. boiling point dec. 315 °C (subl. 88 °C/0.05 Torr).

ln (*P*, atm.) = –13453/(*T*, K) + 24.19 (*T* = 361 - 433 K) (Ref.1)

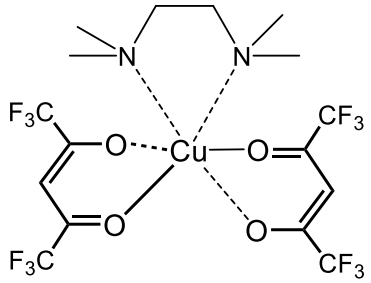
Technical Note:
1. Volatile copper source for MOCVD/ALD applications (Ref.2).

References:
1. Moscow, 1982, 100.
2. Applied Surface Science, 2000, 157(3), 151

Price for 1g **$31.74**
Other quantities are available upon request. Contact NANO3D SYSTEMS LLC for more info.

Cu(tmeda)(hfac)$_2$ **N/A**

Tetramethylethylenediamine bis-(1,1,1,5,5,5- hexafluoro-2,4-pentanedionate) copper, 98%



m.p. 138 **°C,** violet solid. The Cu(tmeda)(hfac)$_2$ sublime without residual up to 220 °C. (Ref.1)

Technical Note:

1. Volatile copper source for MOCVD/ALD applications (Ref.1, 2).

References:

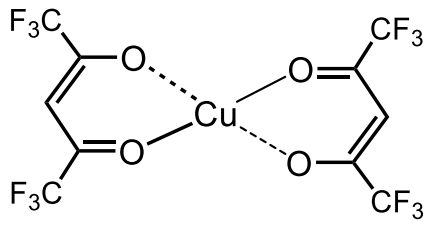
1. ECS Transactions, 2009, 25(8), 549.
2. Crystal Growth & Design, 2009, 9(5), 2470.

Price for 1g **$135.33**

Other quantities are available upon request. Contact NANO3D SYSTEMS LLC for more info.

$Cu(hfac)_2{*}2H_2O$ **CAS Number: 155640-85-0**

Bis-(1,1,1,5,5,5-hexafluoro-2,4-pentanedionate) copper(II) hydrate, 98%



m.p. 130-134 C, dark blue solid, (subl. 94 °C/0.05 Torr).

ln (*P*, atm.) = –9699/(*T*, K) + 21.42 (*T* = 323 - 368 K) (Ref.1)

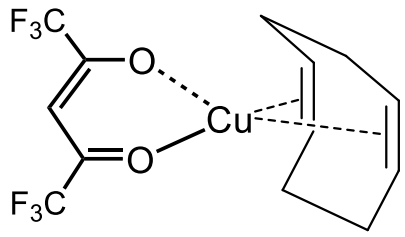
Technical Note:
1. Volatile copper source for MOCVD/ALD applications (Ref.1).

References:
1. Applied physics letters, 1992, 60(1), 50-52.

Price for 1g **$55.46**
Other quantities are available upon request. Contact NANO3D SYSTEMS LLC for more info.

Cu(cod)(hfac) **N/A**

(1,5-Cyclooctadiene) (1,1,1,5,5,5-hexafluoro-2,4-pentanedionate) copper, 98%



m.p.65 C(dec.), yellow solid, (subl. 45 °C/0.05 Torr).

ln (*P*, atm.) = –11660/(*T*, K) + 25.28 (*T* = 298 - 333 K) (Ref.1)

Technical Note:
1. Volatile copper source for MOCVD/ALD applications (Ref.2, 3).

References:
1. Phys. IV France, 2001, 11, Pr.69.
2. Applied physics letters, 1991, 59(18), 2332.
3. Journal of materials research 1992, 7(2), 261.

Price for 1g **$136.98**
Other quantities are available upon request. Contact NANO3D SYSTEMS LLC for more info.