TABELA DE EVAPORAÇÃO DIRETA DE COMPOSTOS INORGÂNICOS

TABLE 10 Direct Evaporation of Inorganic Compounds

Compound	Vapor species observed (in order of decreasing frequency)	mp, °C	T, °C, at which $p^* = 10^{-2}$ Torr	Comments on actual evaporation temperatures, support materials used, and related experience
		Oxides		
Al_2O_3.....	Al, O, AlO, Al_2O, O_2, $(AlO)_2$	2030[154]	~1800[17,152]	From W and Mo supports at 1850–2250°C.[159] With telefocus gun at 2200°C, no decomposition[152] From W support: Al_2O_3 films have small oxygen deficits.[153] O_2-dissociation pressure at 1780°C: 1.5×10^{-18} Torr[153]
B_2O_3.....	B_2O_3[151]	450[154]	~1700[154]	From Pt and Mo supports at 940–1370°C[151]
BaO.....	Ba, BaO, Ba_2O, $(BaO)_2$, Ba_2O_3, O_2[159]	1925[154]	1540[17,154]	From Al_2O_3 crucible at 1200–1500°C.[159] From Pt crucible with only slight decomposition, p_{O_2} (1540°C) = 3.5×10^{-18} Torr[153]
BeO.....	Be, O, $(BeO)_n$, $n = 1$–6, Be_2O[151]	2530[154]	2230[154]	From W support at 2070–2230°C.[151] With telefocus gun at 2400–2700°C, no decomposition[152]
Bi_2O_3.....	.....	817[154]	1840[153]	From Pt support[153]
CaO.....	Ca, CaO, O, O_2[151]	~2600[154]	~2050[17]	Support materials: ZrO_2, Mo, W. The latter two form volatile oxides, molybdates, and wolframates at 1900–2150°C[151]
CeO_2.....	CeO, CeO_2[151]	1950[163]	.....	From W support without decomposition[153]
In_2O_3.....	In, In_2O, O_2[151]	.....	.....	From Pt support with only little decomposition.[153] Vapor species observed at 1100–1450°C. At 1000–1450°C from Al_2O_3 crucible, more In_2O than In[151]
MgO.....	Mg, MgO, O, O_2[151]	2800[154]	~1560[152]	Mo or W supports at 1840–2000° form volatile oxides, molybdates, and wolframates.[151] With telefocus gun at 1925°C, no decomposition.[152] From Al_2O_3 at 1670°C[159]
MoO_3.....	$(MoO_3)_3$, $(MoO_3)_n$, $n = 4,5$[155,159]	795[154]	610[155]	From Mo oven at 500–700°C, the trimer is the main species. Above 1000°C, there is some decomposition into $MoO_2(s) + O_2(g)$.[155] At 730°C, the oxygen-decomposition pressure is 1.1×10^{-14} Torr.[153] From Pt at 530–730°C[158]
NiO.....	Ni, O_2, NiO, O[151]	2090[163]	1586[153]	From Al_2O_3 crucible at 1300–1440°C.[151] Heavy decom-

TABLE 10 Direct Evaporation of Inorganic Compounds (Continued)

Compound	Vapor species observed (in order of decreasing frequency)	mp, °C	T, °C, at which $p^* = 10^{-2}$ Torr	Comments on actual evaporation temperatures, support materials used, and related experience
		Oxides		
				position with $p_{O_2} = 4 \times 10^{-1}$ Torr at 1586°C[153]
Sb_2O_3.....	.....	656[154]	~450[154]	Lower oxides result if evaporated from W supports. Pt heaters do not produce decomposition[153]
SiO.....	SiO	.....	1025[156,157]	Usually evaporated from Ta or Mo heaters at residual gas pressures below 10^{-5} Torr and at temperatures between 1150 and 1250°C. Dissociation into Si and O_2 begins above 1250°C and may lead to oxygen-deficient films[153]
SiO_2.....	SiO, O_2[153,158]	1730[152]	~1250[152]	With telefocus gun at 1500–1600°C, no decomposition.[152] Ta, Mo, W supports are attacked by SiO_2 and contribute volatile oxides.[153] From Al_2O_3 at 1630°C, SiO_2 vapor species is present[159]
SnO_2.....	SnO, O_2[151]	.....	.....	From SiO_2 crucible at 975–1250°C.[151] Films directly evaporated from W support are slightly oxygen-deficient[153]
SrO.....	Sr, O_2, SrO[159]	2460[154]	~1760[17]	From Al_2O_3 at 1830°C.[159] Evaporation from Mo or W at 1700–2000°C produces volatile Mo and W oxides, molybdates, and wolframates[151]
TiO_2.....	TiO, Ti, TiO_2, O_2[153,159]	1840[154]	.....	TiO_2 source material decomposes into lower oxides upon heating.[152,153] p_{O_2} at 2000°C is 10^{-10} Torr. Nearly stoichiometric films by pulsed electron-beam heating[169]
WO_3.....	$(WO_3)_3$, WO_3[155]	1473[154]	1140[155]	From Pt oven at 1040–1300°C.[155] From Pt support at 1220°C.[159] From W heater with only slight decomposition; p_{O_2} at 1120°C is 3×10^{-10} Torr[153]
ZrO_2.....	ZrO, O_2	2700[154]	.....	From Ta support at 1730°C, volatile TaO.[159] From W support, oxygen-deficient films.[153] ZrO_2 source material loses oxygen when heated by electron beams[152]

TABLE 10 Direct Evaporation of Inorganic Compounds (Continued)

Compound	Vapor species observed (in order of decreasing frequency)	mp, °C	T, °C, at which $p^* = 10^{-2}$ Torr	Comments on actual evaporation temperatures, support materials used, and related experience
		Sulfides, Selenides, Tellurides		
ZnS.....	.....	1830[168] ($p \approx 150$ atm)	1000[154]	From Mo support. Minute deviations from stoichiometry if allowed to react with residual gases. From Ta at 1050°C[167]
ZnSe.....	.....	1520[168] ($p \approx 2$ atm)	820[160]	
CdS.....	S_2, Cd, S, S_3, S_4[151]	1750[168] ($p \approx 100$ atm)	670[161]	From Pt oven at 740°C.[151] Films tend to deviate from stoichiometry.[153] Suitable support materials: graphite, Ta, Mo, W, SiO_2, Al_2O_3-coated W; evaporation at 600–700°C[167]
CdSe.....	Se_2, Cd	1250[168]	660[162,163]	From Al_2O_3 crucible[167]
CdTe.....	Te_2, Cd[164]	1100[168]	570[164]	From Ta boat at 750–850°C; film stoichiometry depends on condensation temperature[76]
PbS.....	PbS, Pb, S_2, $(PbS)_2$[151]	1112[154]	675[154]	From quartz crucible at 625–925°C.[151] From Mo support.[153] Purest films from quartz furnace at 700°C; Fe or Mo boats react and form volatile sulfides[165]
Sb_2S_3.....	.....	546[154]	550[153]	From Mo support[153]
Sb_2Se_3....	Sb_4, $(SbSe)_2$, Sb_2, SbSe[151]	611[166]	.....	From graphite at 725°C.[151] From Ta oven at 500–600°C, fractionation and films of variable stoichiometry[166]
		Halides		
NaCl.....	NaCl, $(NaCl)_2$,[151] $(NaCl)_3$	801[154]	670[17,154]	From Ta, Mo, or Cu ovens at 550–800°C[151]
KCl.....	KCl, $(KCl)_2$[151]	772[154]	635[17,154]	From Ni or Cu ovens at 500–740°C[151]
AgCl.....	AgCl, $(AgCl)_3$[151]	455[154]	690[154]	At 710–770°C.[151] From Mo support, $p^* = 10^{-2}$ Torr at 790°C[153]
MgF_2.....	MgF_2, $(MgF_2)_2$, $(MgF_2)_3$[151]	1263[154]	1130[154]	From Pt oven at 950–1230°C.[151] From Mo support.[153] Very little dissociation into the elements[158]
CaF_2.....	CaF_2, CaF[151]	1418[154]	~1300[154]	From Ta oven at 980–1400°C.[151] From Mo support[153]
$PbCl_2$.....	.....	678[154]	~430[154]	Direct evaporation possible[153]