CÁC PHƯƠNG PHÁP CHẾ TẠO MÀNG CƠ

HVTH: PHÙNG VĂN HƯNG

Table 1. Properties of B-N Materials

Property	c-BN	h-BN	a-BN
crystal structure	cubic, zinc blende	hexagonal	amorphous
Lattice constant	a = 3.61 Å	a = 2.50 Å c = 6.60 Å	
Density	3.48 gcm^{-3}	2.2 gcm^{-3}	1.74 gcm^{-3}
Hardness	6000–7500 HV	2 Mohs	200–600 HV
Resistivity - undoped - p-type (Be) - n-type (B)	10^{10} ohm·cm (at RT) 10^{2}–10^{4} ohm·cm 10^{3}–10^{7} ohm·cm	1.7 x 10^{13} ohm·cm	10^{15} ohm·cm
Activation energy	(p) 0.19–0.23eV	(n) 0.05–0.41eV	
Thermal conductiv.	2–9 $Wcm^{-1}K^{-1}$	(c) 0.68 $Wcm^{-1}K^{-1}$ (a) 0.36 $Wcm^{-1}K^{-1}$	
Lin.therm. expans.	4.8 x $10^{-6}K^{-1}$ (700 K)	3.8 x 10^{-6} K^{-1}	

Table 1. Classification of PVD and CVD Processes

PVD Processes

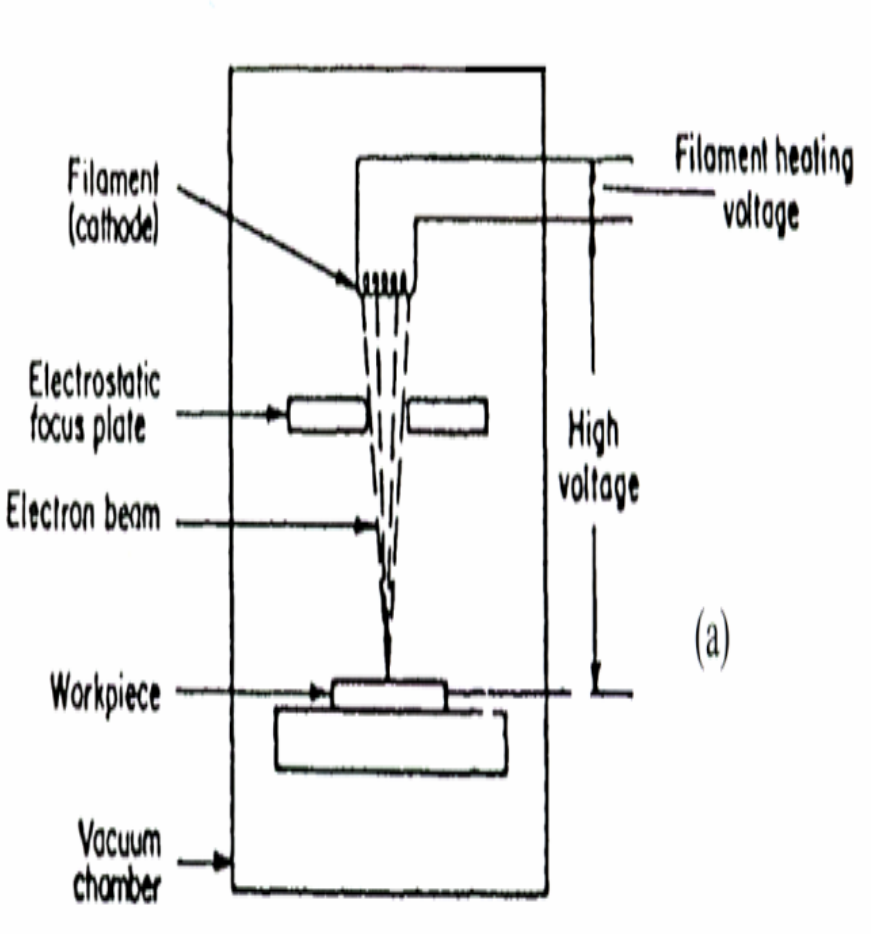
Metals		Compounds
Basic PVD Processes Evaporation Deposition	Direct	Basic PAPVD Processes Activated Reactive Evaporation (ARE)
Sputter Deposition	Evaporation or Sputtering	Reactive Sputtering (RS)
Hybrid PVD Processes Processes		Hybrid PAPVD
"Ion Plating"		"Reactive Ion Plating"

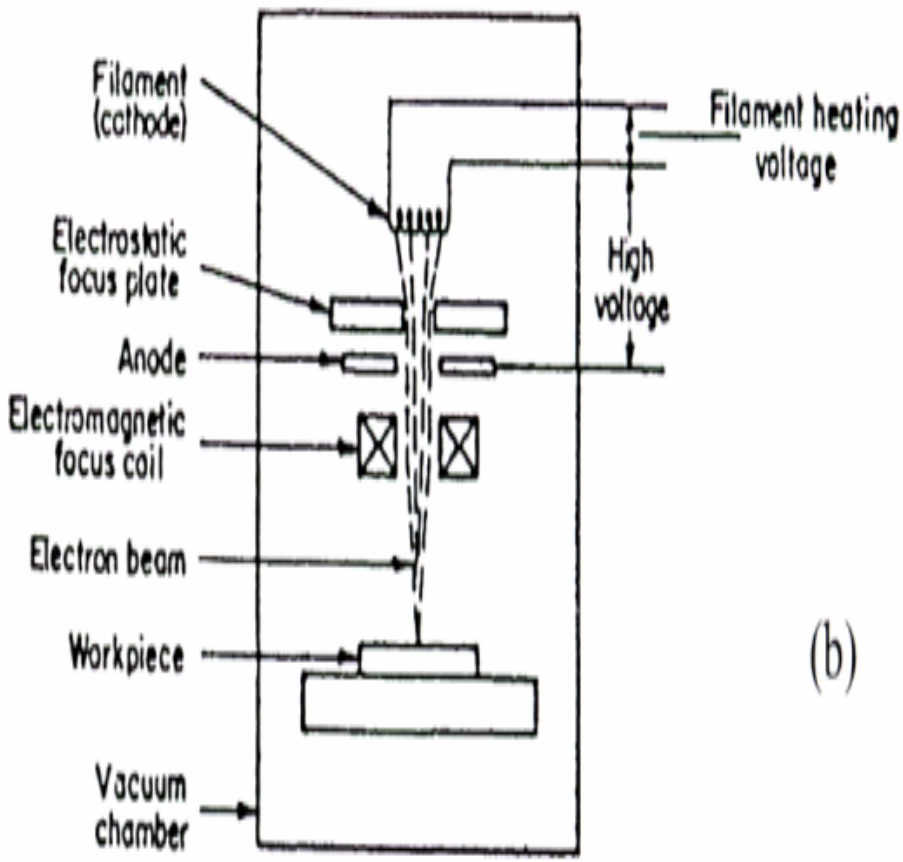
CVD Processes

Basic CVD Process Thermal CVD	Basic PACVD Processes RF Excitation Microwave Excitation Photon Excitation

Table 2. Characteristics of Basic PVD and CVD Processes

	Evaporation	Sputtering	Chemical Vapor Deposition
Mechanism of production of depositing species	Thermal energy	Momentum transfer	Chemical reaction
Deposition rate	Can be very high (up to 750,000 Å/min)	Low except for pure metals (e.g., Cu-10,000 Å/min)	Moderate (200–2,500 Å/min)
Depositing species	Atoms and ions	Atoms and ions	Atoms
Throwing power	Poor line-of-sight coverage except by gas scattering	Good, but nonuniform thickness distribution	Good
Metal deposition	Yes	Yes	Yes
Alloy deposition	Yes	Yes	Yes
Refractory compound deposition	Yes	Yes	Yes
Energy of deposited species	Low (0.1–0.5 eV)	Can be high (1–100 eV)	Can be high with plasma-aided CVD
Bombardment of substrate/deposit	Not normally	Yes	Possible
Growth interface perturbation	Not normally	Yes	Yes (by rubbing)
Substrate heating (by external means)	Yes, normally	Not generally	Yes


Filament
(cathode)
Filament heating
voltage
Electrostatic
focus plate
Electron beam
High
voltage
Workpiece
Vacuum
chamber
(a)


Filament
(cathode)
Filament heating
voltage
Electrostatic
focus plate
High
voltage
Anode
Electromagnetic
focus coil
Electron beam
Workpiece
Vacuum
chamber
(b)

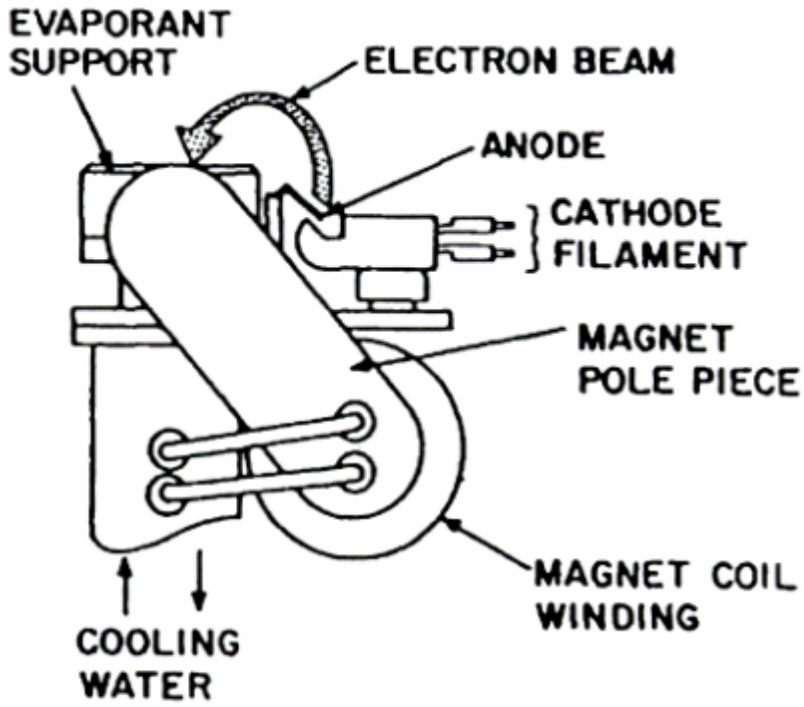


Figure 22. Bent beam electron gun with water cooled evaporant support. (With permission of Temescal Metallurgical Co., Berkeley, CA.) *(From* The Handbook of Thin Film Technology, *©1970, McGraw Hill.)*

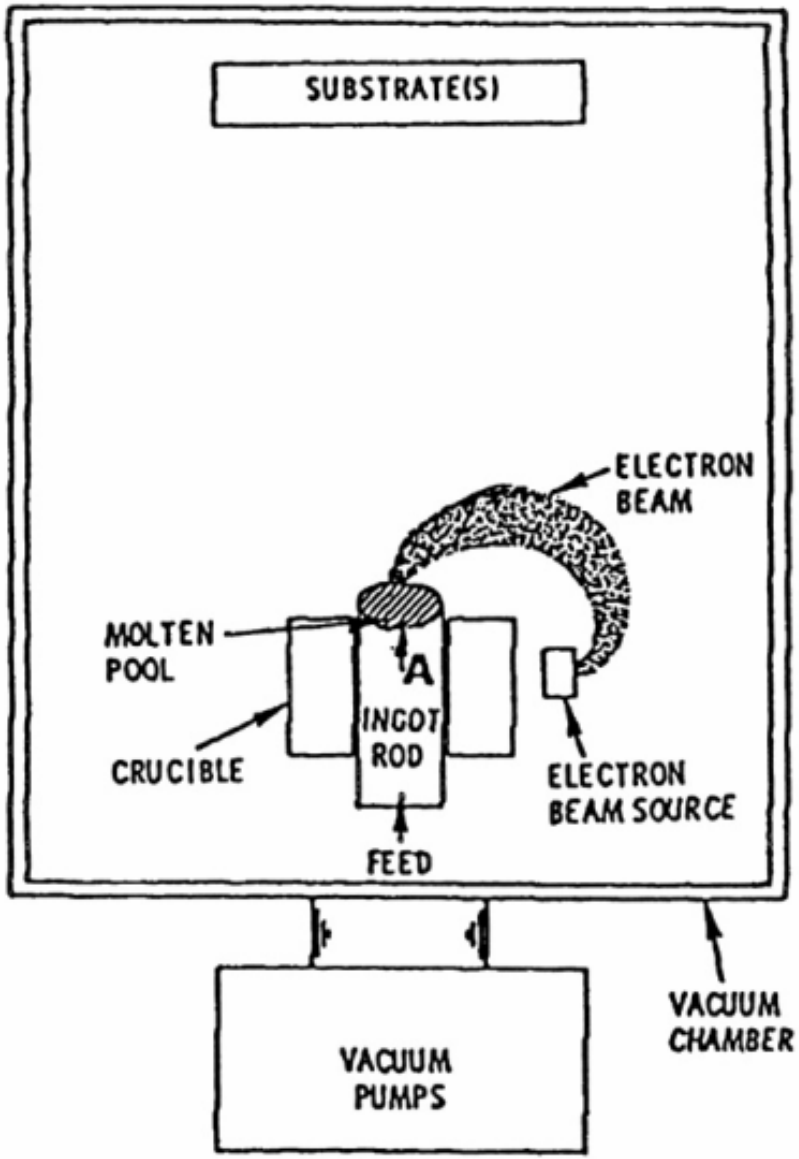


Figure 12. Evaporation deposition process schematic.

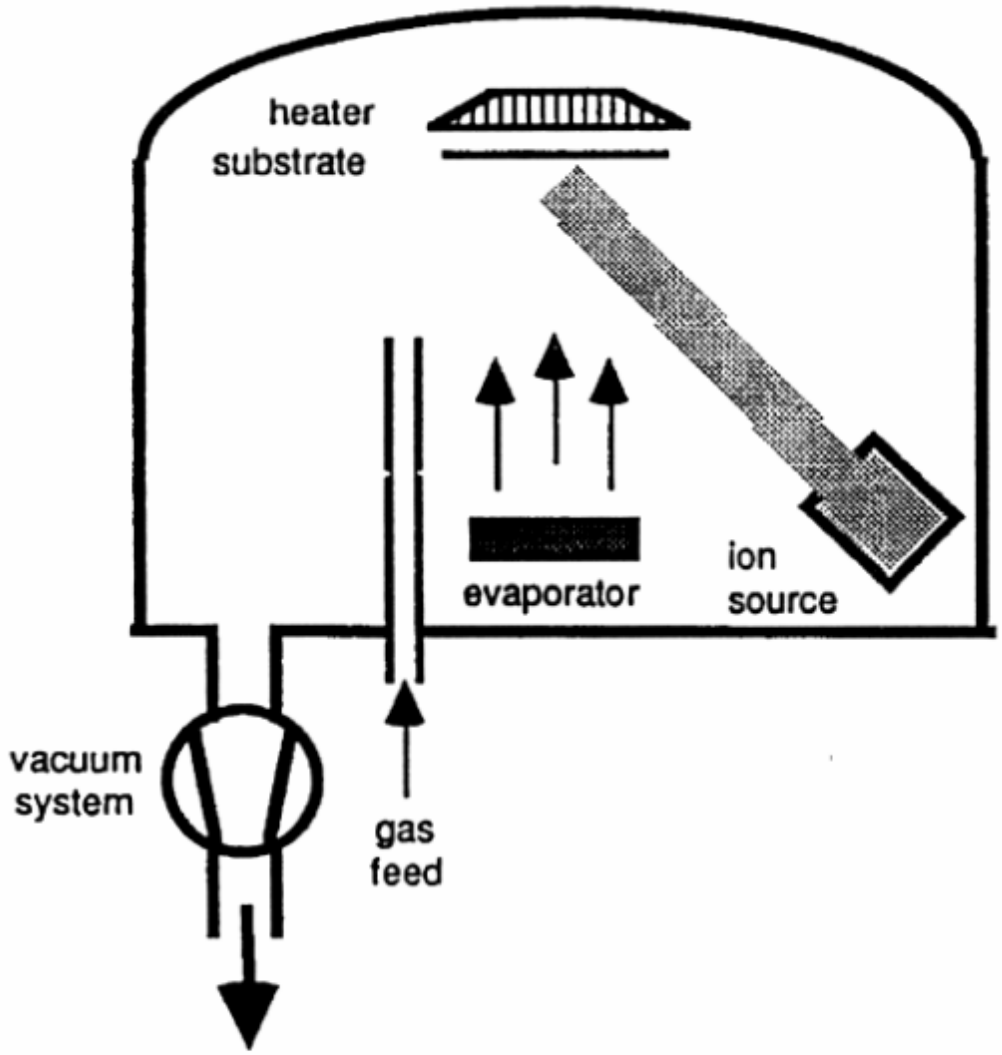


Figure 3. Ion beam enhanced deposition (IBED).

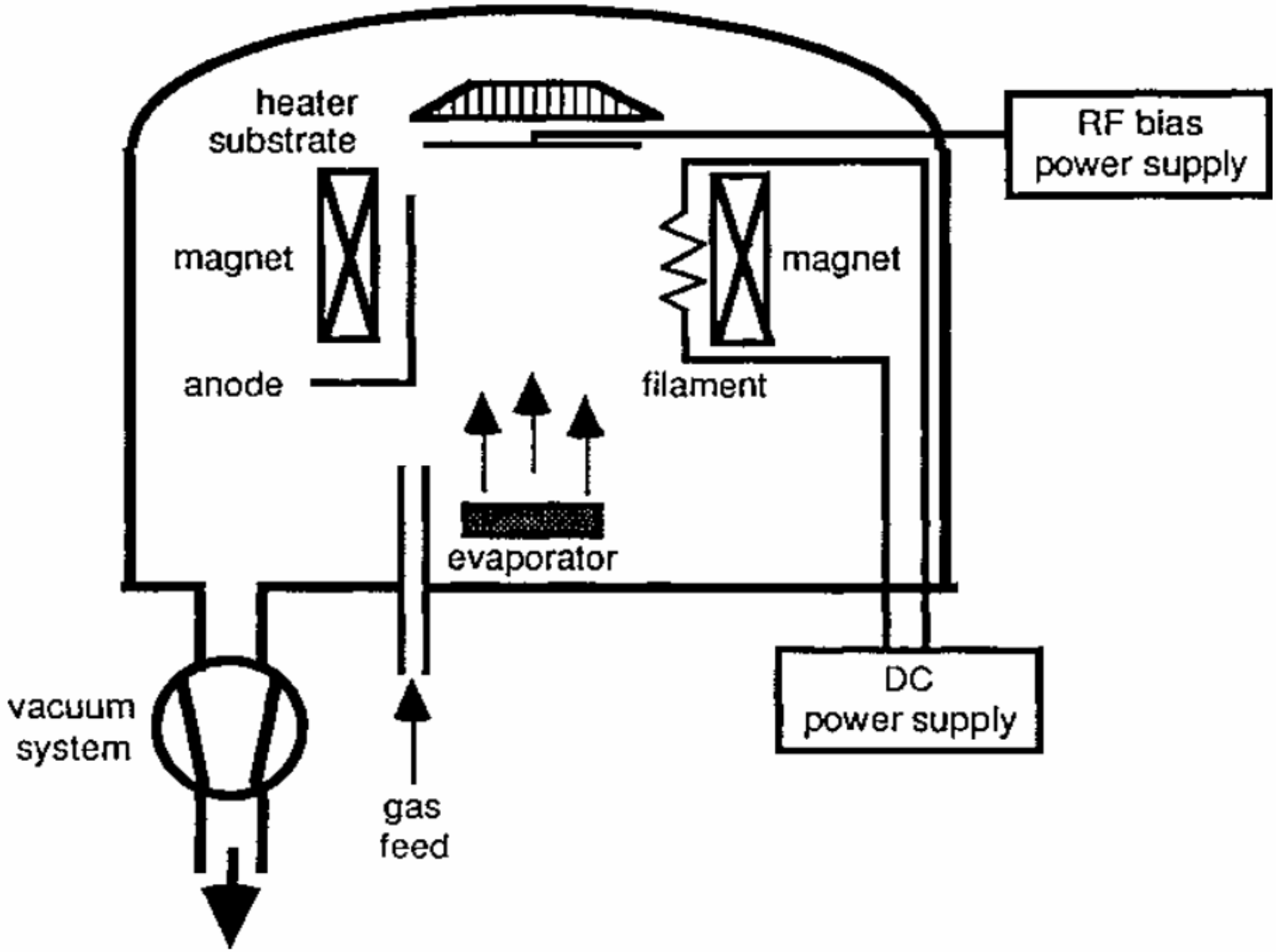
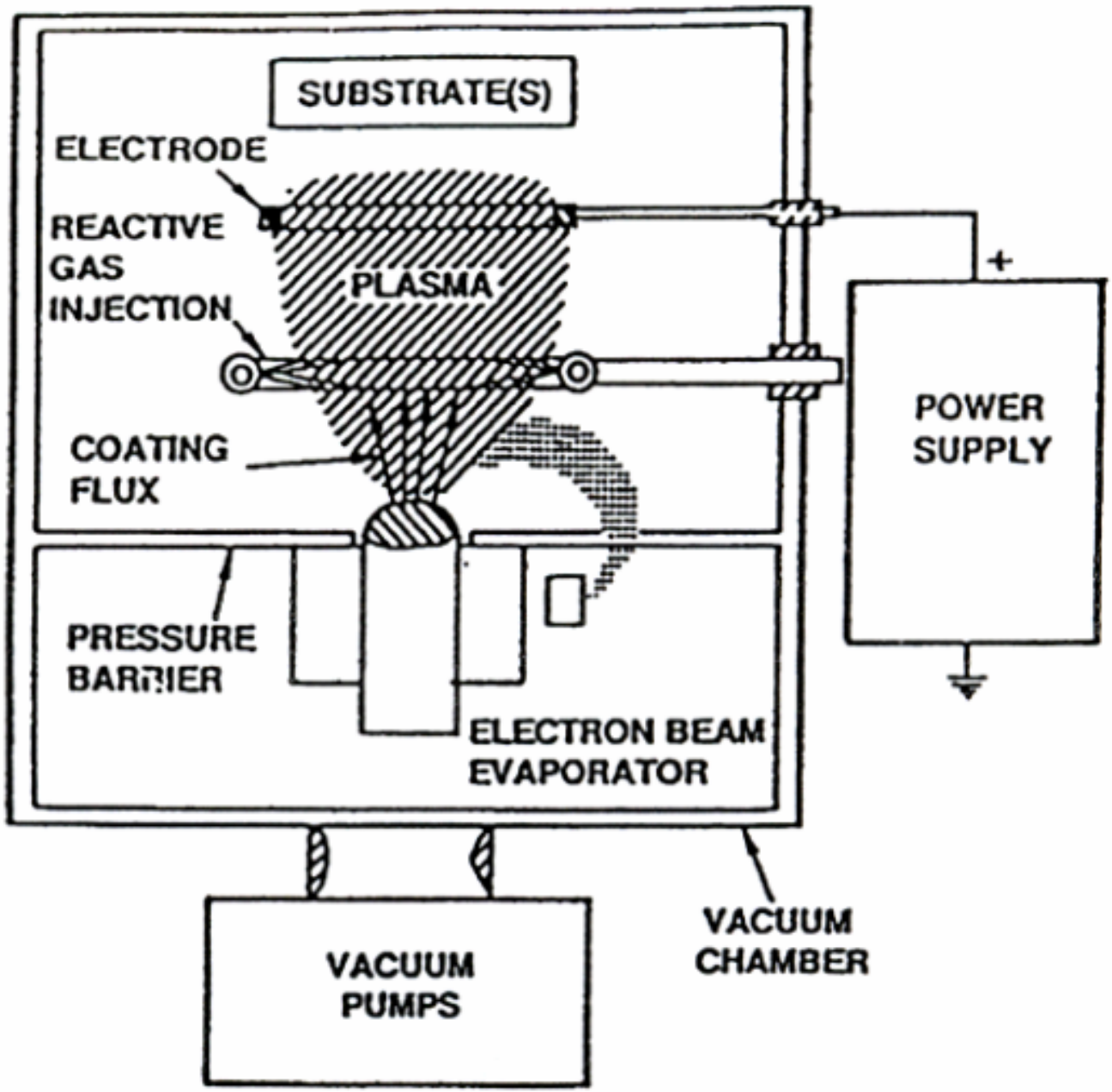


Figure 4. Activated reactive evaporation (ARE/ADRRP).


SUBSTRATE(S)
ELECTRODE
REACTIVE GAS INJECTION
PLASMA
COATING FLUX
PRESSURE BARRIER
ELECTRON BEAM EVAPORATOR
+
POWER SUPPLY
VACUUM PUMPS
VACUUM CHAMBER

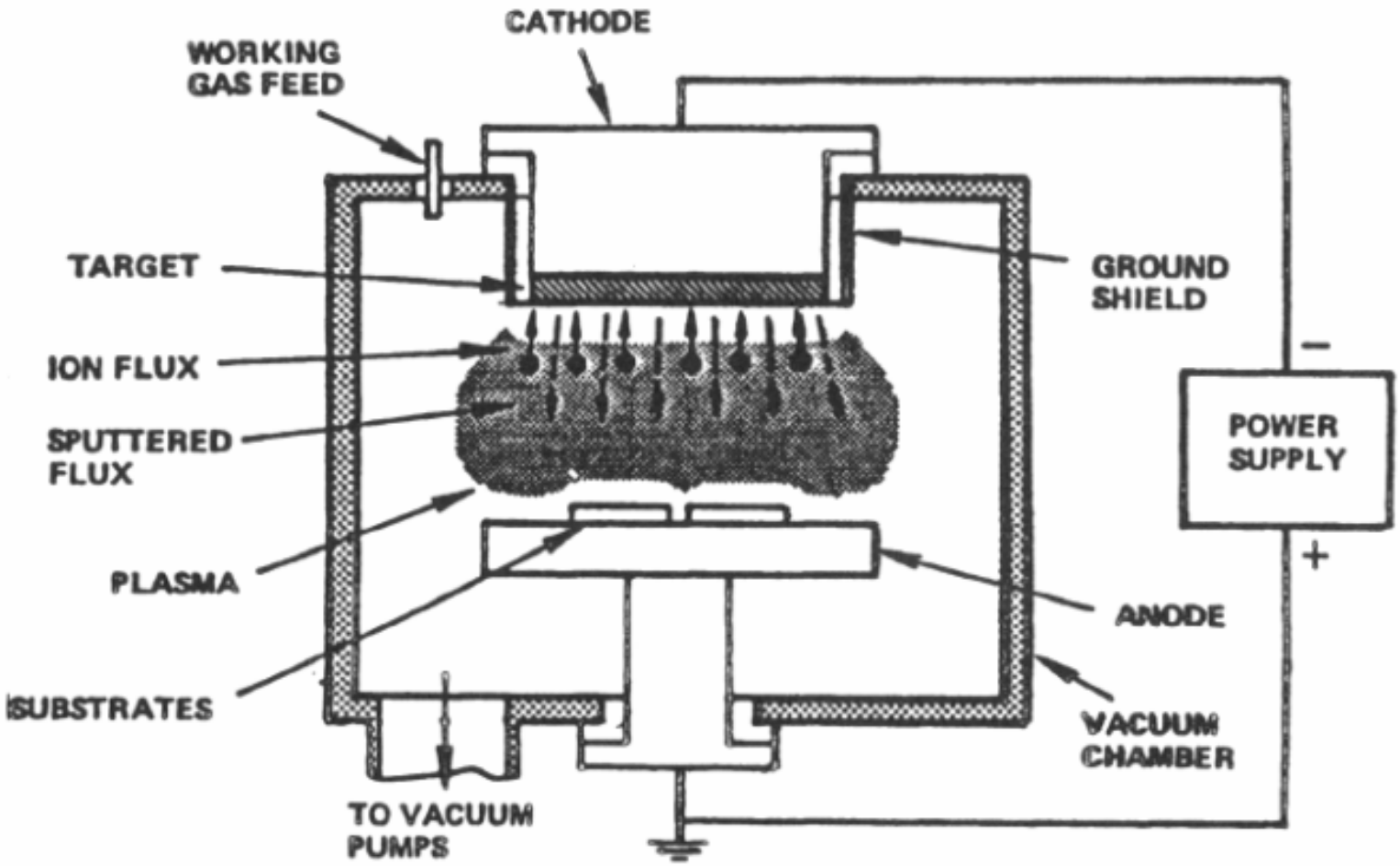
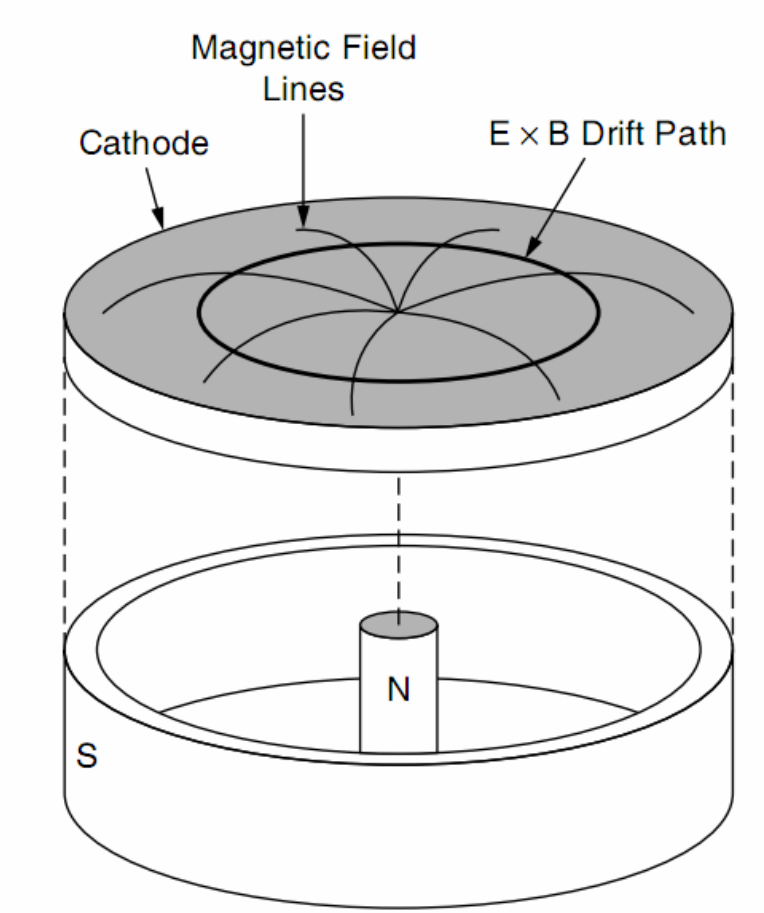
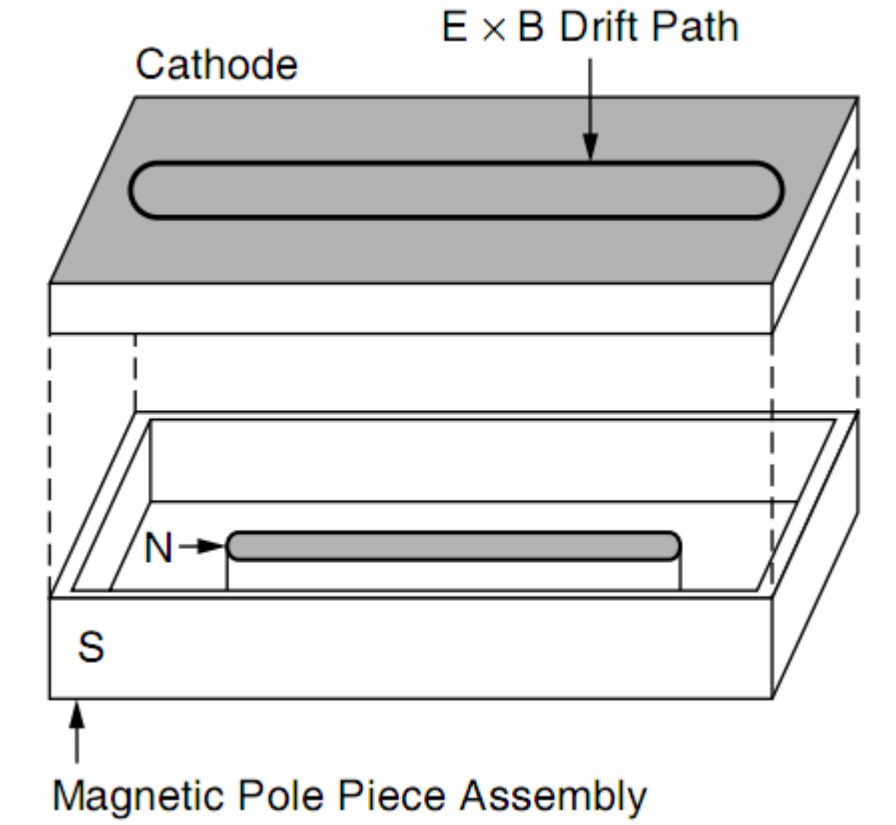
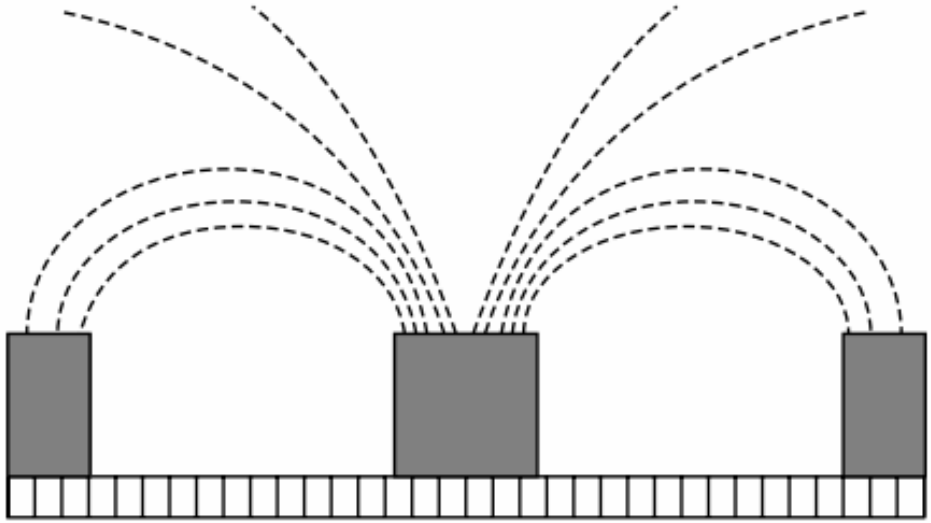


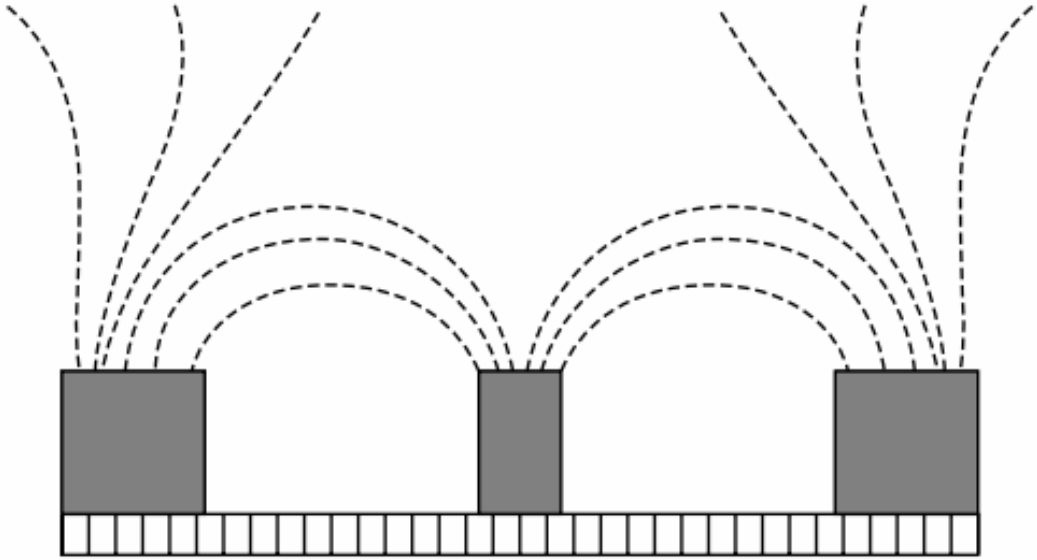
Figure 4. Planar diode sputter deposition.


Magnetic Field
Lines
Cathode
E × B Drift Path
N
S

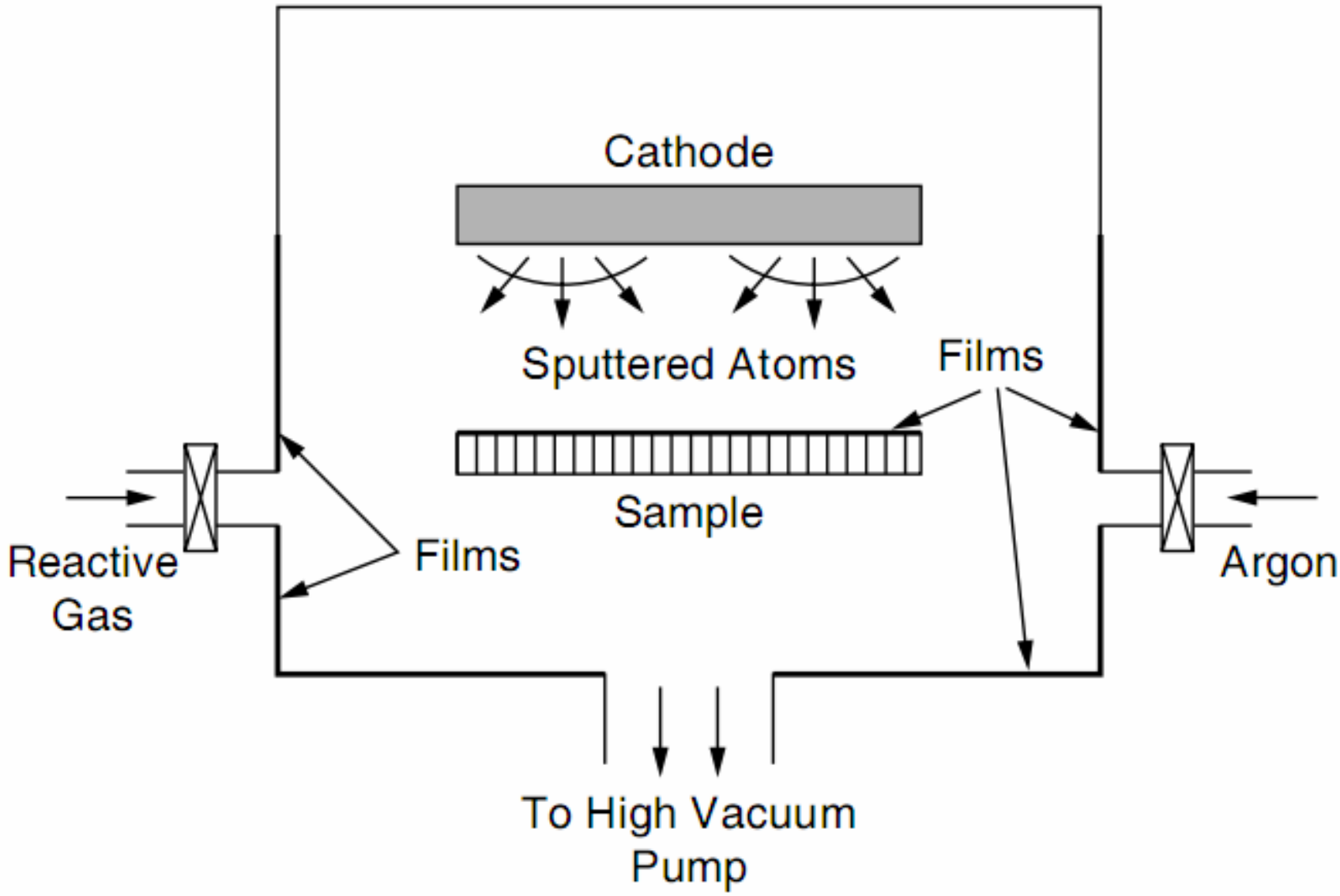

E × B Drift Path
Cathode
N
S
Magnetic Pole Piece Assembly



(a)



(b)


Cathode
Sputtered Atoms
Films
Sample
Reactive
Gas
Films
Argon
To High Vacuum
Pump

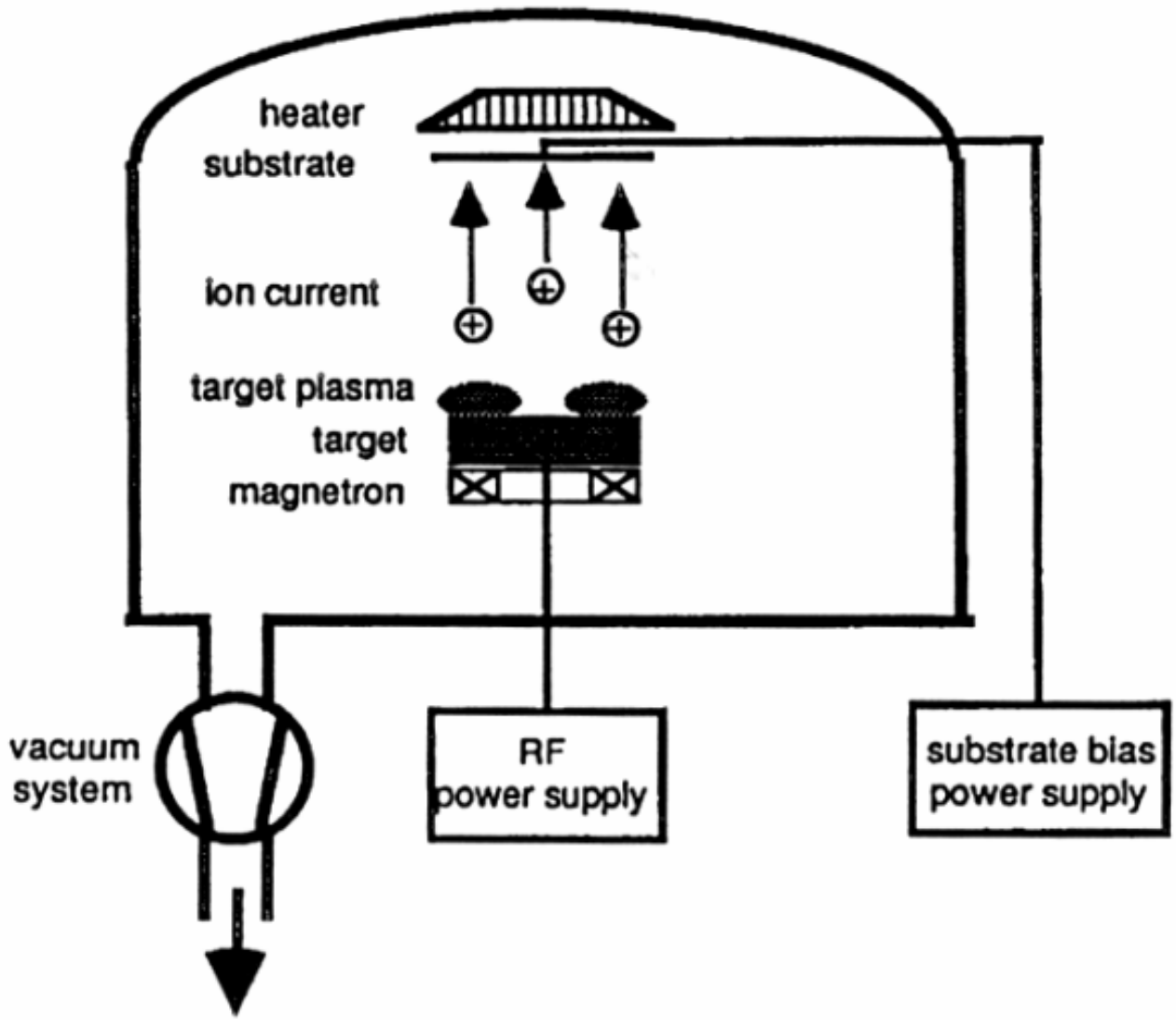


Figure 5. Reactive RF magnetron sputter ion plating (RF-MSIP).

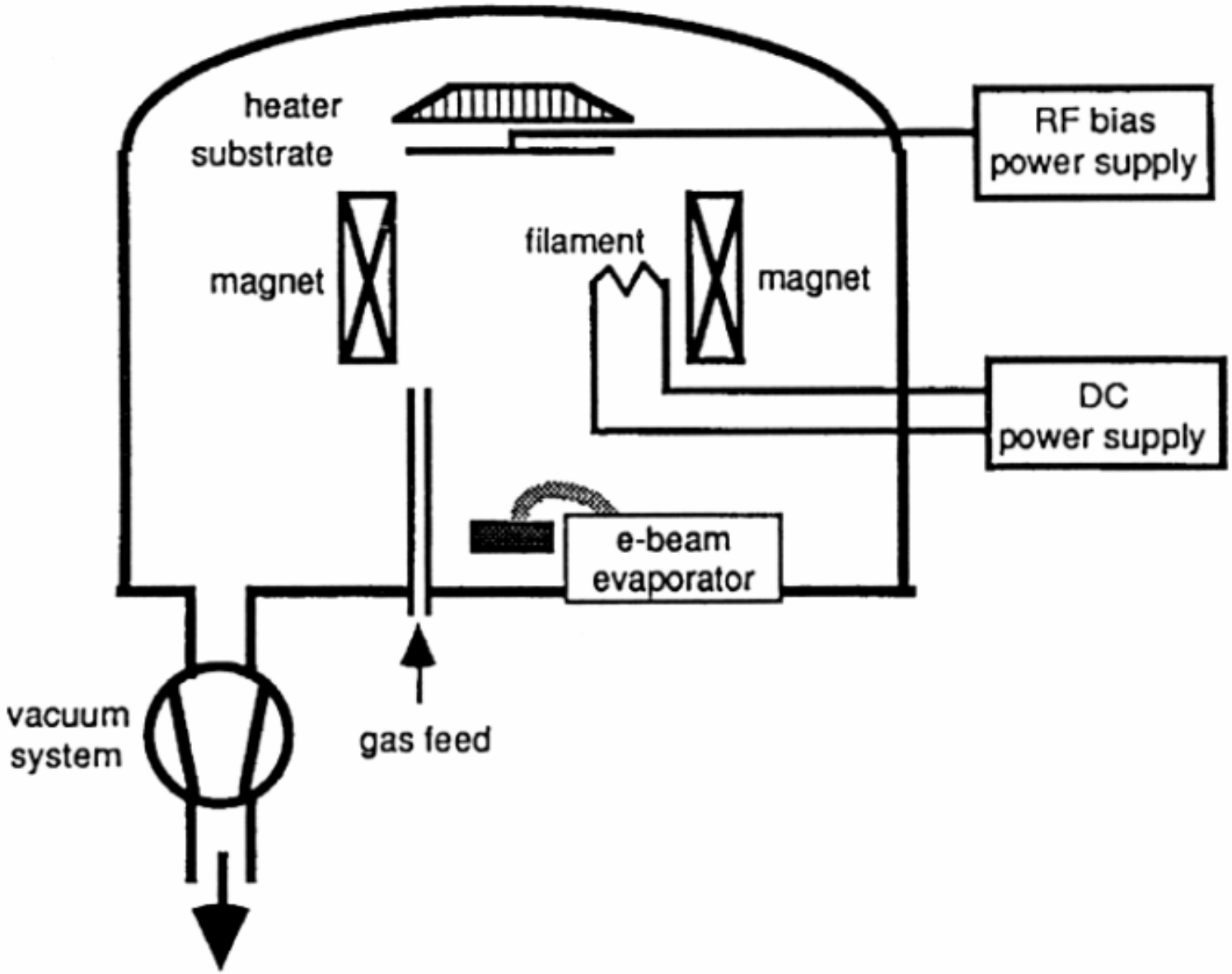


Figure 6. Magnetically enhanced plasma ion plating (MEP-IP).

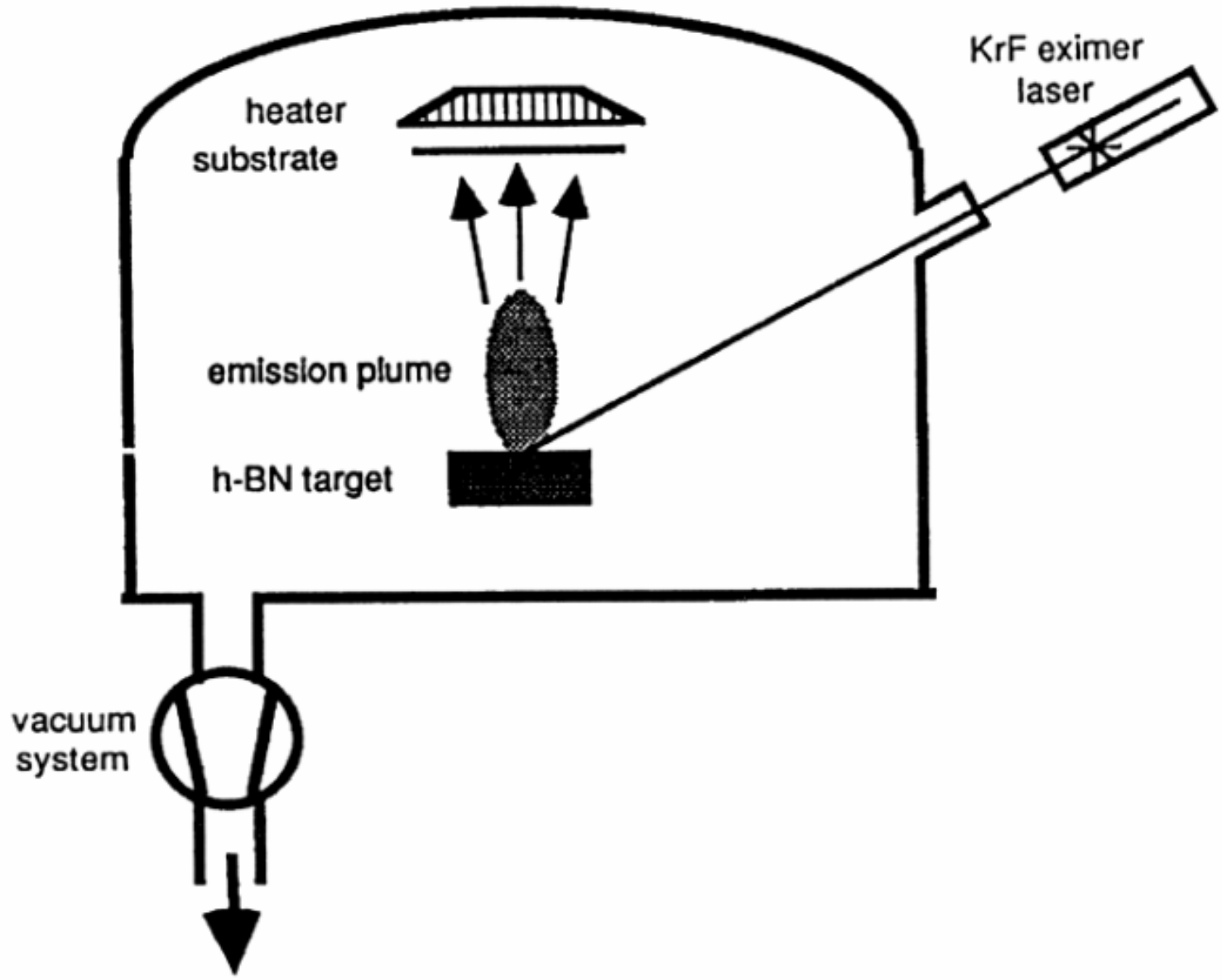


Figure 7. Pulsed laser deposition (PLD).