Interacting with DARPA

Brian Holloway
DARPA Program Manager
Defense Science Office
Brian.holloway@darpa.mil

American Vacuum Society Meeting

October 31, 2011

What makes DARPA unique…

Formed in 1958 to
PREVENT and **CREATE** strategic surprise

Capabilities, mission focused

Finite duration projects

Diverse performers

Multi-disciplinary approach…from basic research to system engineering

As the DoD's innovation engine, we are committed to the boldest, creative leaps…

DARPA Structure

DSO	MTO	I2O	TTO	STO	AEO
Physical Sciences	Basic Science Core	Global ISR	Advanced Weapon Systems	Comms, Networks & Cyber	Agile Programs with Frequent Development Cycles
Materials	Devices	Cyber	Advanced Platforms	Global Tactical ISR	Conduct Systematic Rigorous Assessments
Mathematics	Integration	Social Networks	Advanced Space Systems	Energy	Explore New Contracting Approaches
Training & Human Effectiveness	Power	Computational Social Science		Hybrid Warfare	Develop Strong Relationships
Biological Warfare Defense	Architectures	Language Transparency		Extreme Environments	
Biology	Application	Edge Finding			
		Training / Education			
Defense Sciences Office	**Microsystems Technology Office**	**Information Innovation Office**	**Tactical Technology Office**	**Strategic Technology Office**	**Adaptive Execution Office**

DARPA Accomplishments Timeline


Saturn


Ground Surveillance Radar


M-16 Rifle


Stealth Fighter


Sea Shadow

1960

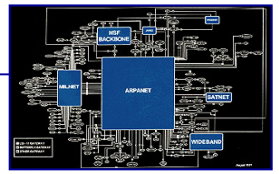

Vela Hotel

1970


ATACMS


JSTARS

1980



Arpanet


GPS


UCAV


TMR

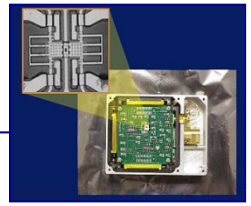

JSF


Uncooled IR


Taurus Launch Vehicle

2000


Global Hawk


MEMS


MALD

1990


BAT


Predator

Working with DARPA

Potential Performers
Industry, Universities, National Labs

Program Manager
Scientist
Entrepreneur
"Angel Investor"

Office Initiatives
(Proof of Concept)

Office Initiative

Customer Request

New Ideas (from PM, Performer, etc)

Step I

- Define Program Goals and Metrics
- Permission to Issue BAA – DARPA Director (Scientist, "VC")

BAA

Step II

- Proposers Day
- White Papers
- Proposal Review
- Select Performers

Contract

Step III

- Program Reviews
- "Decision Point" Evaluations
- DoD transition partners

6 months | **12 months** | **18 months** | **54-60 months**

Idea Development
- *Office Initiative*
- *RFI*
- *Workshop*

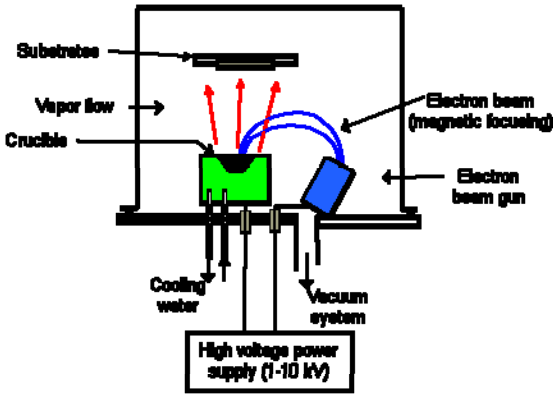
- *Pitch to Director*
- *BAA Issued*
- *Proposers Day*

- *Journal Publications from OBI's*
- *Program Phase I Underway*

Deliverables
- *Publications*
- *Transition*

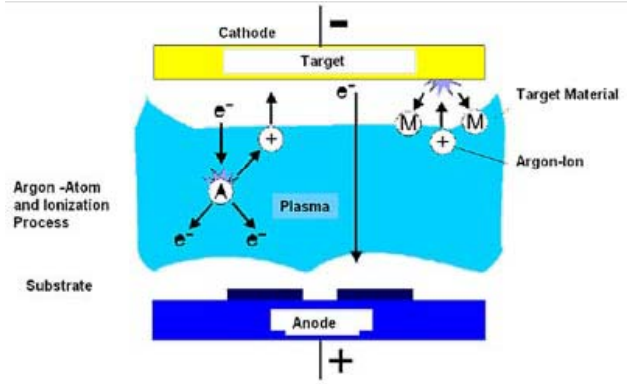
Present day thin film growth processes

- Evaporation (thermal, electron beam).
- Sputtering (inert, reactive gas).
- Molecular beam epitaxy, laser ablation.
- Chemical vapor deposition (CVD), plasma-enhanced CVD.



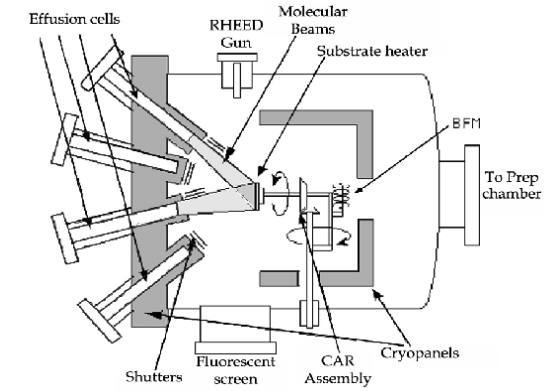
Electron beam evaporation

www.etafilm.com.tw/PVD_Thermal_Evaporation_Deposition.html



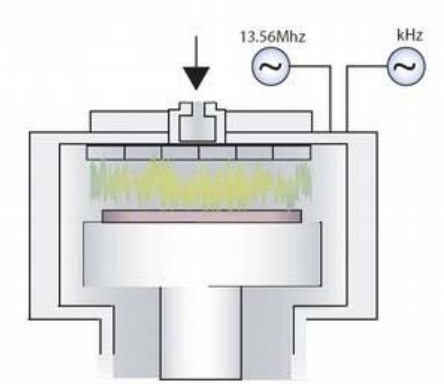
Sputtering

www.svs-vct.com/sputtering.htm



Molecular beam epitaxy

mxp.physics.umn.edu/s07/Projects/S07_Graphene/intro.htm

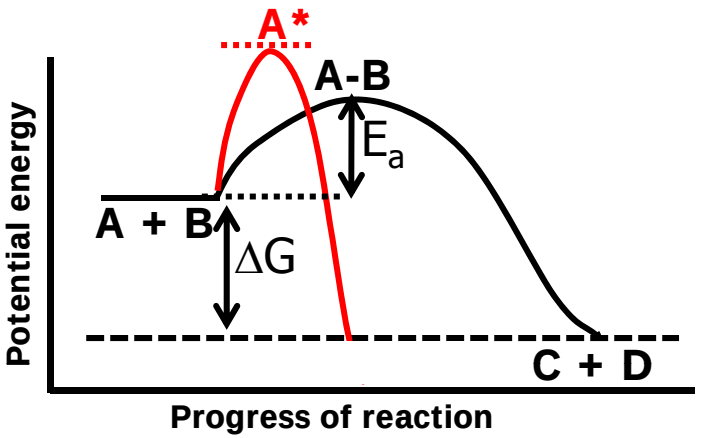


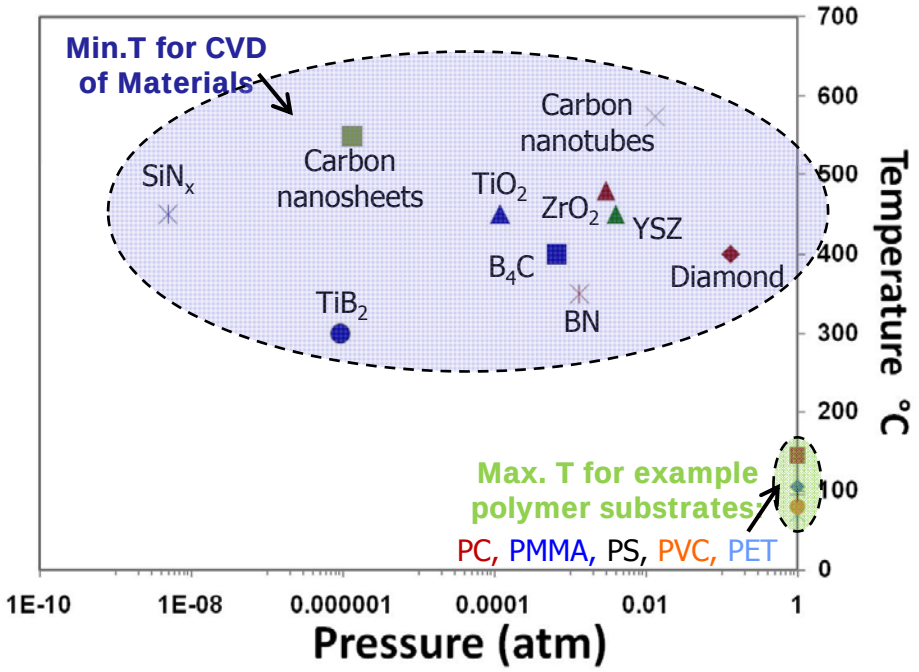
Plasma-enhanced chemical vapor deposition

unit.aist.go.jp/dia-rc/dia-surf/SFD-project-diamond%20growth.html

Current thin film deposition processes

- Proceed via equilibrium macroscopic chemistry and kinetics.
- Driven by ΔG and E_a.
- Extreme bulk temperature and vacuum conditions severely limits the combination of technologically important materials with relevant substrates.





The gap is an engineering limitation, not a fundamental scientific limitation.

Possible tools for Local Control (LoCo)

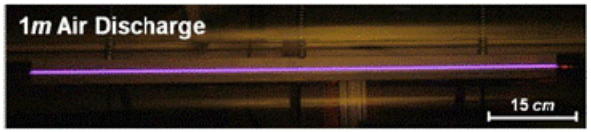
Atmospheric Pressure Plasmas (APP): high flux of energetic reactants to surface.

Types of APPs

- Corona discharges
- High frequency glow discharges:
- Dielectric barrier discharges

Recent Advances

- Power supply power, matching networks, pulse quality
- Understanding of plasma chemistry and physics



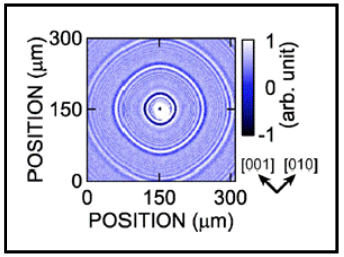
Surface Acoustic Waves (SAW): local energy for surface diffusion without heating.

Example T equivalent calculation

- Pulsed lasers used to induce propagating Rayleigh waves.
- Strain induced by SAWs shown to be on order of that that affects surface adsorbates and dislocations.

Recent Advances

- Development of SAW spectroscopy, with the ability to manipulate and control SAWs (picosecond temporal and micron lateral resolution)
- Buried interface perturbation



Ultrafast Lasers (UL): chemical specificity for bond scission/formation (reactants and substrate).

Critical control properties

- Pulse width
- Photon frequency
- Pulse shape
- Phase

Recent Advances

- Pulse shape, frequency control, and phase optimization for improved selectivity in bond scission and formation
- Higher power, higher frequency lasers