CATHODIC ARC PHYSICAL VAPOR DEPOSITION (CAPVD)

Centre for Engineered Coatings
International Advanced Research Centre for Powder Metallurgy and New Materials
Balapur PO, Hyderabad-500 005, India

Overview

In general, CAPVD is a three step process: (i) Vaporization of required material from a source (cathode) by using an electric arc, (ii) Transport of vaporized material to the destination (target to be coated) and (iii) Condensation of transported vapors on to the targeted object to make a thin film.

The major advantages of the CAPVD include; formation of highly dense and adherent coatings with a good deposition rate and thickness control (± 5 nm). The semi industrial available facility at ARCI is associated with 400 mm length (Φ: 110 mm) cylindrical cathodes which enable reduced droplets formation than any other conventional CAPVD facilities. The maximum dimensions of the target to be coated can be: 350 mm L x 100 mm W (Φ). The CAPVD facility with its unique advantages can be used for developing thin films/ coatings in major sectors like; auto mobile, aerospace, manufacturing, optics, electronics, alternate energy, etc.

Key Features

- **Films/coatings of different structures with good control over chemistry and thickness can be developed: (i). Mono-layer, (ii) Multi-layer, (iii) Gradient and (iv) Functionally multi-layered/graded**
- **Films/coatings containing Ti, Cr, AlSi & AlTi can be coated in pure metallic or nitride or carbide form. i.e. TiN, CrN, TiAlN, TiAlSiN, CrAlSiN, TiCrAlSiN, TiC, TiCN, TiAlCN, etc.**
- **Physical and mechanical properties can be tuned by varying deposition conditions**
- **Environmentally green and easily up scalable process with high production rates**

Applications

- **Hard and wear resistant coatings for cutting tools – up to hardness of 45 GPa**
  - **High speed and dry machining**
  - **Machining of advanced materials: CGI, Ti6Al4V, Inconel 718, etc.**
- **Wear resistant coatings for dies, bearings, etc. – Low friction coefficient of < 0.2**
- **Erosion resistant coatings for compressor blades – A thickness of 20 µm is achieved**
- **Solar selective coatings for solar thermal applications – ~ α: 0.96 & ε: 0.09 at 400°C**
- **Diffusion barrier coatings for electronic components**
- **Decorative coatings for aesthetic applications, etc.**

Hard Coatings on Cutting Tools

Erosion Resistance Coatings for Compressor Blades Tools

Solar selective Coatings for Solar Thermal Receiver Tubes Tools

Technology Status

Intellectual Property Development Indices

IPDI	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
Activities	Basic concepts and understanding of underlying scientific principles	Shortlisting possible applications	Research to prove technical feasibility for targeted application	Coupon level testing in stimulated conditions	Check repeatability/ consistency at coupon level	Prototype testing in real-life conditions	Check repeatability/ consistency at prototype level	Reassessing feasibility (IP, competition technology, commercial)	Initiate technology transfer	Support in stabilizing production
Status										

PEM Fuel Cell Stack Developed at ARCI