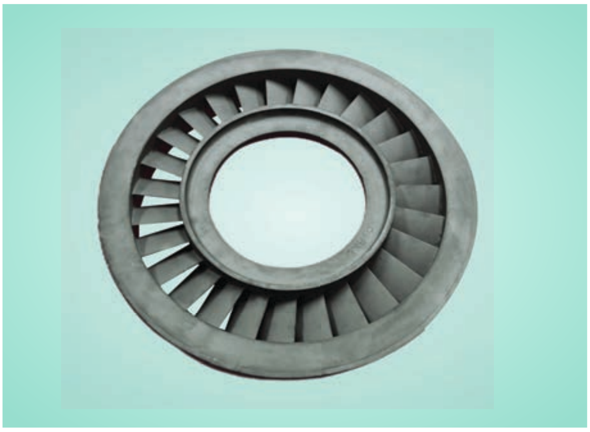
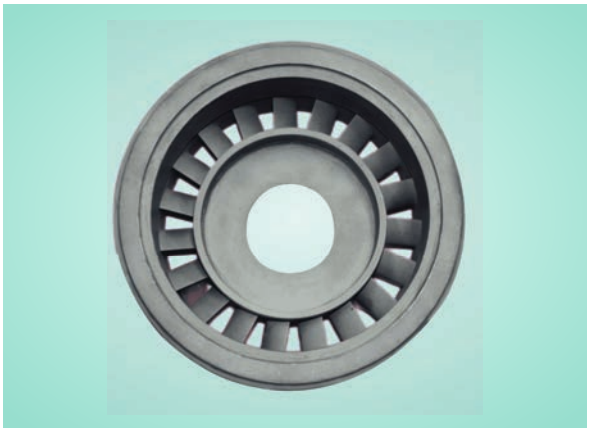
The Defence Metallurgical Research Laboratory (DMRL)

About Lab

The Defence Metallurgical Research Laboratory (DMRL), a premier laboratory of DRDO, under Ministry of Defence is responsible for the development of advanced metallic, ceramic and composite materials, and related processing technologies for various critical defence applications.

Since its inception in 1963, the laboratory has developed and established a number of frontline technologies in the areas of metallurgy and materials science. Extensive state of the art infrastructure for melting, processing and characterisation of materials has been established in the main campus at Kanchanbagh and at the Armour Technology Centre at Devatalagutta.





Fin Stabilised Armour Piercing Discarding Sabot (FSAPDS)

DMRL's focus in armament materials has been on tungsten heavy alloys which are used for anti-tank ammunition in battle tanks. The laboratory has developed the technology for tungsten heavy alloy core rods for Kinetic Energy Penetrators. Mk I penetrators with the capability of achieving a depth of penetration of 350 - 370 mm in RHA steel are currently under production.

Mk II penetrators with the capability of achieving a minimum depth of penetration of 500 mm in RHA steel are currently being developed.R&D activity on futuristic penetrators aimed at achieving depth of penetration of 600 mm and 700 mm, has been initiated. DMRL was also responsible for setting up a manufacturing plant Heavy Alloy Penetrator Project (HAPP) under Ordnance Factory Board at Tiruchirapalli to produce these penetrators in large scale, using DMRL technology.

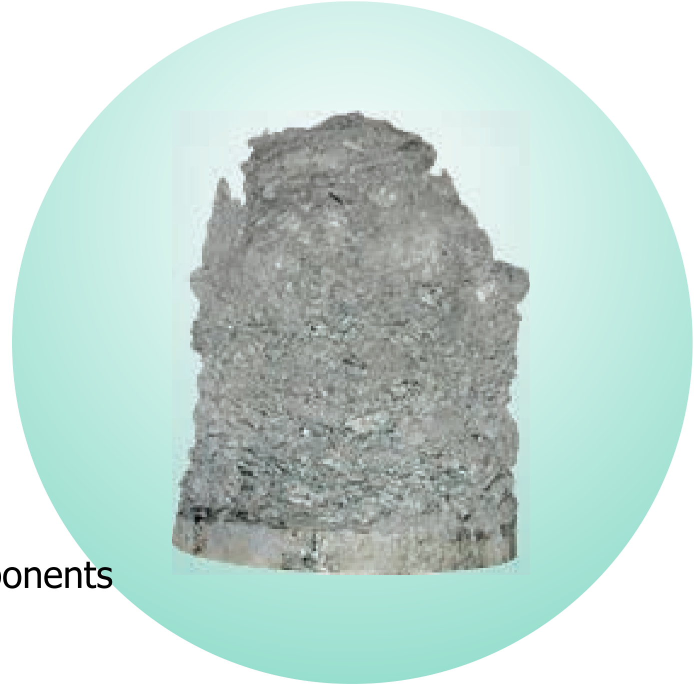
Speciality Steels for Naval Applications

DMRL with support from Indian Navy has successfully developed the technology for production of DMR-249A (Yield Strength ~ 400 MPa) and DMR-249B (Yield Strength ~ 600 MPa) steels using infrastructure existing in the country.

Indian Navy has nominated the use of these steels for all new construction of IN Warships as well as future repairs. The first Indigenous Aircraft Carrier, INS Vikrant II, which was launched in August 2013, has been built entirely with these indigenous steels.

Indigenous Production of Titanium Sponge

DMRL has developed a state-of-the-art technology for Ti sponge production from indigenous raw material ($TiCl_4$) with quality of the sponge meeting international specificatio...



Areas of Application

- Defence and Aerospace (aero engine components
- Naval Systems (ships, submarines)
- Chemical and Power plants
- Biomedical Implants

Transfer of Technology

First commercial plant for Ti sponge production has been set up in the country based on technology developed at DMRL, funded by VSSC

- Plant inaugurated on February 27, 2011 with a capacity of 500 MT per year
- The plant is regularly producing titanium sponge to meet the requirements of strategic applications in the country
- With the joint efforts of DMRL, RCMA (Materials) and KMML, the titanium sponge produced has been certified for aero and naval applications

Achievement for the Country

- Self-reliance with respect to Ti metal for critical applications
- India is 7th nation in the world producing aeronautical grade Ti sponge on industrial scale

Titanium Alloy Drop Link for Tejas

Drop Link is a part of the landing gear of fighter aircraft Tejas Mark-II, manufactured at Hindustan Aeronautics Limited (HAL), Bengaluru with DMRL technology.

- The alloy can replace Ni-Cr-Mo steel forged parts in air craft structures resulting in considerable weight savings
- ADA has identified about 15 components presently made of Ni-Cr-Mo steel to be replaced by this alloy

Isothermal Forging of Ti Alloy Disc for Jaguar Fighter Aircraft

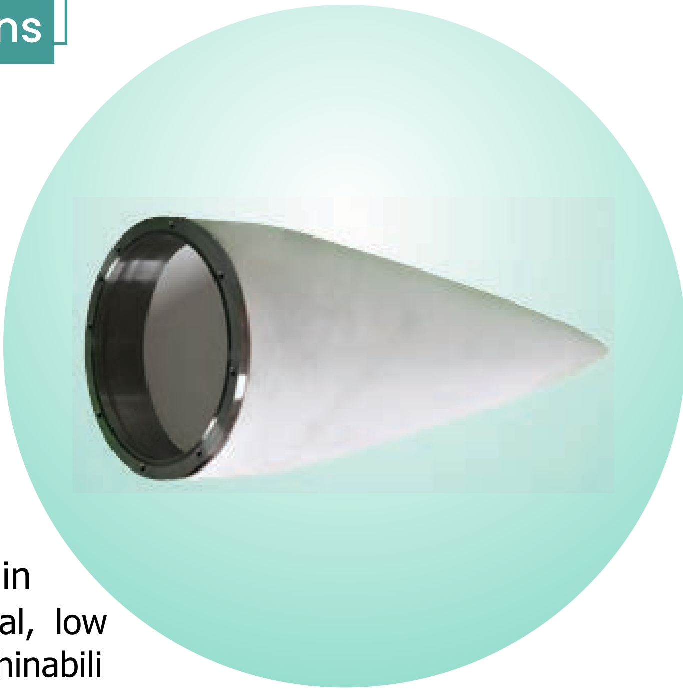
DMRL has successfully developed indigenous isothermal forging technology for manufacturing critical components like Discs, Shafts and Blisks of Adour engine for Jaguar fighter aircraft. The technology is available for indigenous production of feedstock in the form of billets and bars at Midhani, Hyderabad while the technology is available for fabrication of discs & shafts at DMRL and blades and rings at HAL, Bangalore. The technology transfer for indigenous production of Adour engine discs is under negotiation with HAL / Midhani.

Directionally Solidified and Single Crystal Blades &Vanes for Gas Turbine Engines

DMRL has developed vacuum investment casting technology to produce state-of-the-art Directionally Solidified (DS) and Single Crystal (SX) blades and vanes for gas turbine aero engines. Directionally Solidified turbine blades and vanes are columnar grained hollow castings with thin walled aerofoils between two shrouds.

The castings are produced via vacuum investment casting process using Ni-base superalloys. Ceramic silica cores are used to get hollow cast components. Single crystal turbine blades and twin vanes are produced by using orthogonal grain selector from advanced Ni-base single crystal alloy. These components have been developed for gas turbine engines of aircraft for high efficiency, high thrust and low specific fuel consumption.

Silica Radomes for Missile Applications



DMRL has developed Silica Radome technology indigenously in view of its current and future requirement in large numbers for target seeking missiles. The DMRL technology is based on Cold Isostatic Pressing (CIP) and sintering which has been established for the first time in the country. The main advantages are indigenously available raw material, low manufacturing cost, consistent properties, good machinability and high component yield. The main advantages are indigenously available raw material, low manufacturing cost, consistent properties,good machinabili-ity and high component yield. DMRL developed Radomes have been successfully integrated with Astra Missile. The technology for silica Radomes has been transferred to (i) M/s MIDHANI (ii) M/s CEL and (iii) M/s BEL for large scale production.

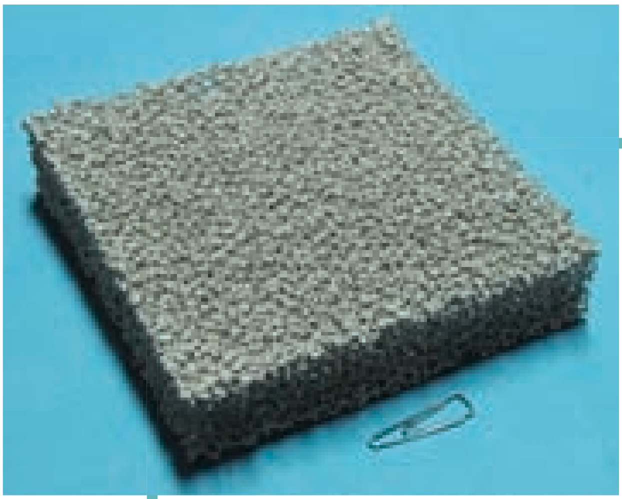
Cf-SiC Composite Nose Tip &Wing Leading Edge for Hypersonic Technology Demonstrator Vehicle (HSTDV)

DMRL has developed critical components for Hypersonic Technology Demonstrator Vehicle which is powered by a scram-jet engine.

The components are made by Chemical Vapour Infiltration and Deposition (CVI-CVD) of SiC into Carbon fibre performs. The Cf-SiC composite has excellent thermal shock resistance and strength retention up to 1500 °C. The Nose Tips & Wing Leading Edges of Hypersonic Vehicles have been developed to resist high heat flux and temperatures. These are potential thermo-structural material.

Metal Foams

Metal foams are ultra light weight material which can absorb impact and blast energy efficiently. DMRL has developed Al, Ni and Ni-Cr-Mo superalloy foams. An excellent combination of unique properties makes these foams attractive candidate materials in defence, aerospace and civilian applications. Open cell Ni foam (30 ppi, 0.5 g/cc) developed by DMRL has been successfully used as secondary wick (Liquid acquisition baffle in Loop Heat Pipe) on GSAT-19 Satellite launched in June 2017.



Properties

High porosity (> 90 %), Low thermal conductivity, High specific surface area, High permeability, High damping capacity, High specific strength and High Specific stiffness

Applications

Heat exchangers, Wick in Loop Heat Pipes (LHP), Interlayer in between Metal-Ceramic Joints, Catalysis (as support material), Filtration & separation, Flame arresters, Battery electrodes (Ni-Cd and N-MH)

Cu-Ti Non Sparking Tools

DMRL has developed a Cu-4.5Ti alloy for manufacturing non-sparking tools as a substitute to toxic and expensive Cu-Be alloys. The alloy possesses good conductivity and strength. Typical non-sparking tools developed are: Scrapers, Knifes, White Bits, Hacksaw Blades, Spatula, Hexagonal Chisels.

Advantages

Non-toxic and the problem of health hazards does not arise, Lower cost as Ti ores are in abundance

Applications

Non-sparking tools are widely used in mining, petroleum and explosive handling industries in defence as well as civil sectors

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