MATERIALS FOR ROCKETS AND MISSILES

DORAIRAJ R
I. Selection of Materials

- High Specific Strength.
- High Specific Modulus.
- Fabrication Easiness.
- Easy availability.
- Critical requirements.
- Service Conditions.
II. Special Requirements Under Adverse Conditions

- High Pressure.
- High Temperature.
- Thermo-Structural needs.
- Soft Magnets.
- HED Permanent Magnets.
- Bi-metallics.
- Opto-Electronics.
- Electro-Optics.
TYPES OF MATERIALS

2. Composite Materials.
3. Thermo-Structural Materials.
5. Special Materials.
6. Chemicals.
1. Structural Metallics.

- i) 15 CDV6: Low carbon steel used in solid rocket motor case.
- ii) M250: Maraging steel with high strength and high toughness used in booster solid rocket motor case.
- iii) Titanium alloy: (Ti-6Al-4V) used in high pressure gas bottles.
iv) Aluminium Alloys: used in liquid propellant tanks, engine components, airframe in Reusable Launch Vehicles.


v) Magnesium/ Mg-Lithium alloys: used in upper stage structure like payload adopter, avionic decks, equipment bay structure.

vi) Powder metallurgy products: used in nozzle throat for bi-propellant control thrusters.
2. Composites

i) Carbon F / Kevlar F – Epoxy Resin: used in solid motor case, pressure vessel, interstages, payload adopter.

ii) Carbon C / Silica C – Phenolic Resin: used in ablative liners, nozzle throat inserts.
3. Thermo-Structurals

- i) Carbon Fibre/ Silicon Carbide Ceramic Matrix
  Used in nose-cap of heat-shield, leading edge and control surface of RLV.

- ii) SiC F/SiC Ceramic Matrix Composite: used in high temperature / hot structures.
4. Thermal Protection System

- i) Carbon/Carbon Composite: used in nozzle throat, nosecone (SiC Coating).
- ii) Silica tiles: (Silica Fibre in Si gel) used in space shuttle and SRE (capsule) mission.
- iii) Polyurethane foam insulation for cryogenic propellant tanks and subsystems.
- iv) Flexible Reusable Surface Insulation-FRSI Blanket / felt with Teflon coating used in leeward surface of RLV.
i) Soft magnetic alloy: Fe-Co-V : used in torque motor in spacecraft.

ii) HED permanent magnet: Sm-Co : used in gyroscope, inertial navigation, guidance & control system, reaction momentum wheel in spacecraft.

iii) Bimetallics: (SS-Al and SS-Ti) used in Cryosystem for assembly of dissimilar items.
iv) Opto-electronics: used in photo sensors and photo diodes and photo voltaic devices for power generation in satellites.

v) Electro-optics: used in High resolution imaging in Spacecrafts.
6. Chemicals

- i) Different coating materials are used for protection and imparting certain characteristics to surfaces, potting of connectors.
- ii) Variety of adhesives/bonding agents are used in processing, installation of sensors, assembly and integration operations.
- iii) Most of these chemicals are polymers.