**Material Considerations**

Aluminium (and its composites): lightweight and sturdy. Need external thermal blanket, which can be made from ceramic tiles. Titanium alloys to strengthen the body.

The ISS has up to 10 cm shielding around the aluminium shell of each module. Common materials include titanium, Kevlar (impact-resistant material to ensure meteoroids or debris do not damage the structure) and ceramics.

NASA was the first to use welded aluminum-lithium alloy Al 2195 at cryogenic temperatures, incorporating it into the External Tank under circumstances that demanded innovation (NASA). But this material has challenges related to difficulty of repair and fracture toughness (resistance to crack propagation under stress), especially cryogenic.

All five Orbiter vehicles used graphite/epoxy doors, one of the largest aerospace composite applications at the time, and performance was excellent throughout all flights. Not only was the expected weight saving achieved and thermal-structural stability was acceptable, NASA later discovered that the graphite/epoxy material showed an advantage in ease of repair (NASA).

<https://www.nasa.gov/centers/johnson/pdf/584729main_Wings-ch4c-pgs200-225.pdf>

Graphite/epoxy composite materials are being used increasingly for numerous space applications. Engineers are interested in these materials because of their favorable mechanical characteristic of high strength/high stiffness to weight ratio and potential for zero or near-zero coefficient of thermal expansion (Lukez, n.d.).

<https://digitalcommons.usu.edu/cgi/viewcontent.cgi?article=2354&context=smallsat>

Metamaterials optical solar reflectors, surface thermal coating.

Anwesha - Found ESA and JAXA database, NASA has restricted access

<http://esmat.esa.int/Services/stress_corrosion/Table_I/table_i.html>

<https://science.nasa.gov/science-news/science-at-nasa/2001/ast14mar_1#:~:text=Titanium%2C%20Kevlar%2C%20and%20high%2D,orbit%2C%20minimizing%20weight%20is%20crucial>.

Need coating on the guest module junction to avoid cold welding.

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| --- | --- | --- |
| **Material** | **Location** | **Advantages** |
| Aluminium alloy 1000 series | Both host and guest (Use coating non-metallic on both surfaces interface) | Applicable to all physical conditions |
| Aluminium 7068? |  |  |
| White ceramic plasma electrolytic oxide coating | Covering guest where it contacts with the host | Thermal controlling, low absorptance, Good adhesion, Low outgassing, Eco-friendly, suitable for complex geometries, resistance for space environment good  (used by ESA for advanced Mercury missions) |

<http://esmat.esa.int/Services/stress_corrosion/Table_I/table_i.html#AluminiumAlloys>

<https://blog.keronite.com/thermal-control-coatings-for-extreme-space>