A Novel Production Method of Millimeter-wave Absorber with a 3D-printed Mold

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Motivation

• To suppress “Stray Light” in radio telescopes
• Requirements for the absorber used in a cryogenic system
  • High absorption rate
  • Low reflectance on the surface
  • Good performance in cryogenic condition
    • cold resistance
    • thermal conductivity
    • Optional: Adhesion performance on metal

New Production Method

We propose a new production method of an absorber with periodical pyramid surface shaped by a 3D-printed mold

Advantages:

1. Quick R&D / mold fabrication
   • Fabrication of the 3D printed mold is short period from design to fabrication. (1 fab. iteration ~ one week)
   • Easy to make various shape absorbers to adjust a mounting point in the telescope.
2. Ability to select the absorptive material
   • By using a material suitable in cryogenic system, the absorber gets good cryogenic performance.

PolyJet 3D-printer of Stratasys Japan Ltd.

• Good fineness: ~30 μm
• Quick fabrication (like ink-jet paper-printing)
• Less absorptive: ~50% wt @ 100 GHz

Stycast2850FT

• Good adhesive performance in low temperature (CTE agreement with aluminum)
• Good thermal conductivity (~64mW/mK @ 4K)

Sample

HFSS simulation

Absorptive material

3 times liquid N\textsubscript{2} dunking

A 10x10cm prototype is adhered to an aluminum plate (t1 mm)

• There is no crack.
• Does not peeled off the aluminum plate

Conclusion

The new absorber production method by 3D-printed mold has good optical performance & cryogenic performance. Its advantages are quick R&D and the selectable absorptive material, which make easy to optimize the absorber for each application.