

## Development of 3D-printed beam windows for COMET Phase alpha and Phase 1

The COherent Muon to Electron Transition (COMET) project is at operation of phase- $\alpha$  in J-PARC Hadron experimental facility. The project objective is to explore the lepton flavor violation process by searching the neutrino-less conversion of muons into electrons. In the beam line, the muon transport solenoids are composed of superconducting magnets which are kept cool by liquid Helium (LHe). The installed beam windows should be robust enough to withstand against the rapid and high pressure increase over 0.3 [MPa] in emergency of LHe quenching until rupture disks break. In a same time, for high transmission efficiency the material density must be low, and the thickness must be as thin as possible, while minimizing the nuclear heat generation by beam energy loss. Thus, for the phased- $\alpha$  we have developed the 3D-printed windows made by Ti-6Al-4V which has radius curvature on to the beam passing area, instead of a conventional thin and flat shape.

Now we started the R&D of the beam windows for coming phase-1. In the phase, the proton beam power will be increased to 3.2 [kW] and there are other beam windows to be developed. At present we focus on the development of the window for the beam duct. The window needs to satisfy; (1) installed in bore diameter of 260 [mm], (2) bonded with diameter of 250 [mm] Aluminum duct, (3) withstands over 0.3 [MPa] in emergency, (4) sustains atmospheric pressure from opposite face of the window in operation condition. By the R&D we decided to manufacture the window by 3D-printer with the material AlSi10Mg which can weld to the beam duct directly to maximize the beam passing area. In the presentation we present the R&D results and history of Ti64 window for phase- $\alpha$  and the progress of the Aluminum alloy window for phase-1.

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