Progress in Development of Silica Aerogel for Particle and Nuclear Physics Experiments at J-PARC

M. Tabata[#] and H. Kawai

Chiba University, Chiba, Japan

 # corresponding author: E-mail makoto@hepburn.s.chiba-u.ac.jp

This paper presents recent progress in the development of hydrophobic silica aerogel as a Cherenkov radiator and an ultra-slow muon source, to be used in several particle and nuclear physics experiments (for example, the E03, E07, E14, E16, E34, E36, E42, and P50 experiments) which are to be conducted at J-PARC near future. A conventional production method [1] allows us to produce low density aerogels for use as a room-temperature thermal-muonium-emitting material for ultra-slow muon production [2]. A new technique [3,4] for synthesizing silica wet gels, in combination with the supercritical carbon dioxide drying method, enables us to produce highly transparent aerogels (transmission length $\Lambda_T \sim 50$ mm at 400 nm wavelength) in the intermediate-refractive-index range ($n \sim 1.05$). Recently, this technique has been extended to a lower range of $n \sim 1.03$ allowing us to produce extremely transparent aerogels with $\Lambda_T = 60–70$ mm. By using a state-of-the-art technique called "pin drying" [5,6] for generating high-density wet gels, we can produce high-refractive-index ($n > 1.05$) aerogels with high transparencies ($\Lambda_T \sim 60$ mm). Moreover, the pin-drying technique enables us to create ultrahigh-refractive-index aerogels up to $n = 1.26$ with reasonable transparencies ($\Lambda_T \sim 20$ mm). Recently another achievement has been large aerogel tile production [7]. We have succeeded in manufacturing 18 cm × 18 cm × 2 cm aerogels with $n \sim 1.05$ and no cracking. To produce more transparent large area aerogels with no cracking, we are now reconsidering the classical supercritical ethanol drying method. The first large-area tile with $n = 1.06$ was successfully obtained by this ethanol method in March 2014.

References

[1] I. Adachi, *et al.*, Nucl. Instrum. Methods A **355**, 390 (1995).
[2] P. Bakule, *et al*., Prog. Theor. Exp. Phys. 103C01 (2013).
[3] I. Adachi, *et al*., Nucl. Instrum. Methods A **553**, 146 (2005).
[4] M. Tabata, *et al*., Nucl. Instrum. Methods A **668**, 64 (2012).
[5] M. Tabata, *et al*., Nucl. Instrum. Methods A **623**, 339 (2010).
[6] M. Tabata, *et al*., Phys. Proc. **37**, 642 (2012).
[7] M. Tabata, *et al*., Nucl. Instrum. Methods A (2014), in press.