A windowless gas target for low-energy ^{12}C (^{4}He, ^{16}O) γ experiment --- Improvement to reduce ^{16}O backgrounds ---

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At Kyushu university tandem laboratory, we are measuring ^{12}C (^{4}He, ^{16}O) γ reaction cross section by using a windowless He gas target and a ^{12}C beam below 6 MeV and by detecting ^{16}O recoils. The He gas target must be windowless, because a high-intensity and low-energy ^{12}C beam makes a pin-hole in polymer window foils, and metal window foils cause too much energy losses of low-energy particles.

Our windowless gas target is a blow-in gas target (BIGT), whereas conventional ones are blow-out gas target (BOGT). Our previous BIGT consisted of a beam entrance tunnel (2.5ϕ x12^{L}), a target center (20ϕ x20^{L}) and a beam exit tunnel (4.5ϕ x12^{L}), and He gas was blown into the target center from walls of the tunnel. Thickness of the He target was 2.7kPa x 4.4cm (=22 $\mu g/cm^2$), which was enough for the ^{12}C (^{4}He, ^{16}O) γ experiment.

We found severe problem of ^{16}O backgrounds from the target cell. A part of stray ^{12}C beam hit inner wall of the tunnels and ^{16}O recoils came out of the wall, because the brass wall surface was oxidized. Since the number of ^{16}O recoils from ^{12}C (^{4}He, ^{16}O) γ reaction is small as a few events per hour, ^{16}O backgrounds are very harmful.

In order to eliminate the ^{16}O backgrounds from the windowless gas target tunnels, we covered the surface of the tunnels by gold, first by gilding, next by evaporating gold, last by putting gold foils. The ^{16}O recoils from the tunnel surface were reduced to about 1/10 in number but still harmful. There may be oxide on the surface of the gold cover.

To reduce the surface area hit by the stray beam, we enlarged the diameter of the tunnels and inserted apertures made of thin gold plate. The ^{16}O backgrounds were sufficiently reduced at first, although the target thickness became about a half.

After a long-term experiment with an intense beam, however, the ^{16}O backgrounds increased in number. We guessed its origin, and improved sticking method of the aperture plates. Now a long-term experiment has started, and we will report the result of the improvement in INTDS2014.