# Development of a new gas cell for $^{20}$Ne$(\alpha,\alpha')$ measurement

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$\alpha$-condesned states are expected to emerge in light self-conjugate A = 4n nuclei [1], and such nuclei are extensively studied from both theoretical and experimental sides. However, there exists poor experimental data for heavier nuclei than $^{16}$O. We have proposed the experiment to measure alpha inelastic scattering from $^{20}$Ne and the decay alpha particles from the excited states simultaneously. We also need to take the data of angular distribution of elastic and inelastic scattering for and multipole decomposition analysis (MDA).

In order to measure the inelastically scatterd alpha particles and the decay alpha particles in coincidence, the thickness of the window foils for the $^{20}$Ne gas target must be as thin as possible is needed, because the decay alpha particles from $\alpha$-condensed state are considered to be lower than a few MeV. Therefore, we need to develop a new gas cell with thinner window for the gas target system at RCNP [2].

For normal measurements without decay particle detection, a wide window gas cell with 4 $\mu$m-thickness Aramid window is used. This cell has the windows size of 40 mm $\times$ 14 mm, and can be operated at up to 100 kPa. Figure. 1 is the picture of the wide window gas cell.

For decay particle measurement, thinner window is needed. We have tested the silicon nitride ($SiN_x$) membrane provided by Silson Ltd. [3]. The $SiN_x$ membrane has the window size of 10 mm $\times$ 10 mm and the thickness is 50 nm. The membrane has endured up to 7.0 kPa pressure difference. The mass thickness of the membrane is 15 $\mu$g/cm$^2$, and this is thinner than the the mass thickness of 5 mm-t $^{20}$Ne gas at 6.0 kPa and 90 K (80 $\mu$g/cm$^2$). The energy loss of the 1 MeV alpha particles in the entrance and exit windows with the $SiN_x$ membranes is about 50 keV in total.

In June 2014, elastic and inelastic scattering have been measured at WS cource with Grand Raiden using 400-MeV $^4$He$^{2+}$ beam. Typical energy resolution of the incident beam is around 200 keV in FWHM.

The wide window gas cell was used during the experiment, and the pressure and the temperature were monitored and recorded. Figure 2 shows a part of recorded gas pressure data during the experiment, and shows that the gas pressure has been kept around 80 kPa during the measurement without any visible gas leakage, although the pressure periodically changed due to the temperature variation of the cell during the cooling cycle.

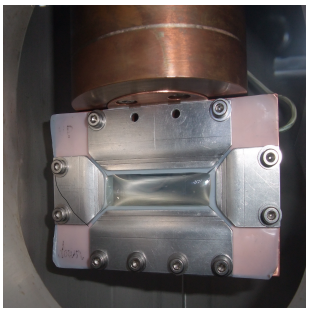

Figure 1: Wide window gas cell.

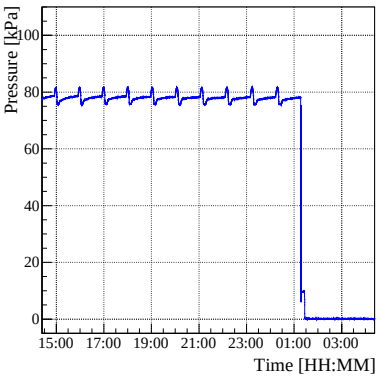


Figure 2: $^{20}$Ne gas cell pressure.

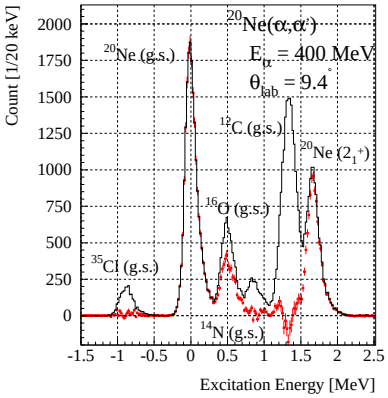


Figure 3: $^{20}$Ne excitation energy spectrum.

The data analysis is now ongoing. A typical excitation energy spectrum of $^{20}$Ne at $\theta_{lab}$ = 9.4° deg is shown in Fig. 3. The black solid line is the spectrum with the backgrounds from window foils (Aramid). The red dots with error bars are the background-subtracted spectrum using the emty-cell measurement. Although the background from $^{35}$Cl, $^{14}$N and $^{12}$C of Aramid is successfully subtracted, $^{16}$O background remains. It is considered that there have been $H_2O$ contaminant inside the cell.

## References

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