§6. Energy Broadening of a Au^+ Ion Beam of Tandem Acceleration

Taniike, A. (Grad. Univ. Advanced Studies)
Sasao, M., Fujita, J.
Wada, M. (Dept. Electronics Doshisha Univ.)

A tandem acceleration test stand (Fig.1.) has been constructed to develop a heavy ion beam probe for potential measurement. A Au^- beam from a plasma-sputter-type negative ion source[1] was injected into the charge exchange gas cell, and the energy spectrum of the Au^+ ion beam was measured. A typical spectrum is shown in Fig.2.

The energy width was measured as a function of the tandem acceleration voltage or the gas pressure, p . Figure3. shows the energy width when the target gas is argon. The energy width, W, can be divided into two terms, a constant term W_0 and a term of being proportional to the gas thickness, as the following,

$$W = \sqrt{W_0^{\ 2} + (\alpha \cdot p)^2} . \qquad (1)$$

After the correction of the intrinsic experimental resolution, the constant term W_0 in the energy width includes the energy loss resulting from the electron transfer process. The energy loss due to the nuclear scattering can be estimated by L.S.S. theory[2] and the inelastic energy transfer by the Firsov theory[3].

In case of the argon gas target, the maximum energy loss due to the nuclear scattering into the largest angle which is geometrically possible, is much smaller than the experimental energy width. It is possible that the inelastic energy transfer is larger than the expected value by the Firsov theory.

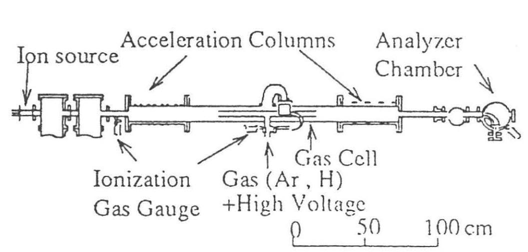

Fig.1. A schematic view of experimental set up.

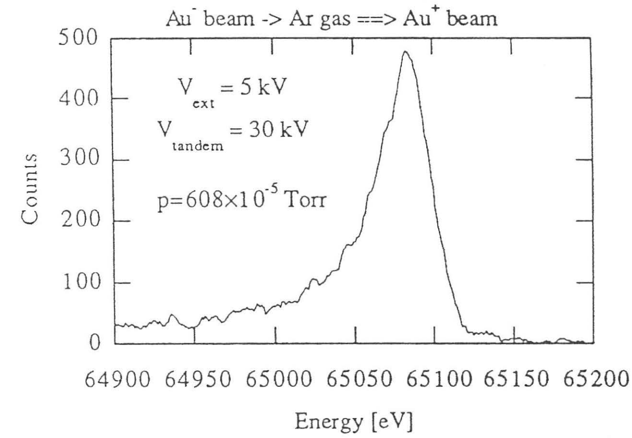

Fig.2. An energy spectrum of Au^+, converted from a Au^- beam in an Ar gas. The tandem acceleration voltage is V_{tandem} = 30kV and the gas pressure is p = 608×10^{-5} Torr.

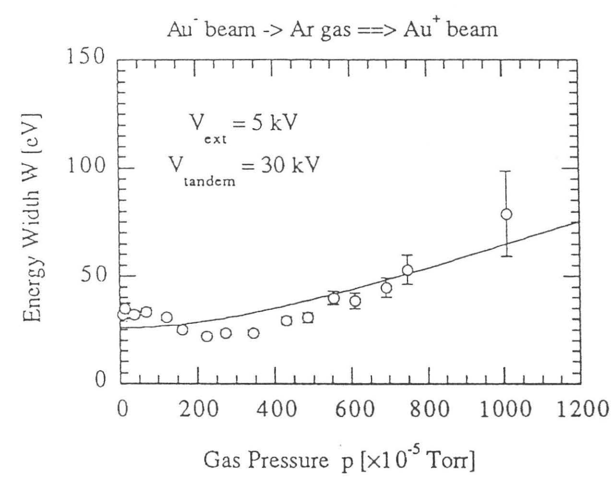

Fig.3. The energy width as a function of Ar gas pressure, when the tandem acceleration voltage is V_{tandem} = 30 kV.

References
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