

MEASUREMENT OF CHARGE-EXCHANGE FRACTIONS FOR As^+ AND AlF^+ ION BEAMS

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The efficient production of As^- and F^- beams for injection into the tandem requires the optimization of the equilibrium charge state fractions. For optimum negative-ion yields, the exchange partner, the target thickness, and to a lesser degree the collision energy, have to be chosen judiciously. With this purpose in mind we have studied the negative-ion formation process in Cs and Mg vapors. The measurements were made at the UNISOR separator using beams of As^+ and AlF^+ from an EBP ion source.

Figure 1 displays a typical measured variation of the charge state fractions with the target thickness for 50 keV As^+ ions impinging on Mg. Such curves were recorded by slowly heating and cooling the charge exchange cell. The target thickness is deduced from the measured temperature and known vapor pressure. After exiting the collision region, the ion beams corresponding to the different charge states were separated in an electric field, recorded simultaneously on different Faraday cups, and normalized to the total detected beam intensity. The neutral-beam current is deduced from the secondary electron emission. As such, the measurements are insensitive to fluctuations in the incident beam intensity and changes in the beam transmission. The resulting equilibrium fractions are compiled in Table 1. The results for the atomic projectile As^+ are accurate to about 1%. The data for the molecular projectile AlF are however preliminary, since in the reaction, charged and neutral fragments of both Al and F are produced, and we only recorded the negative and neutral fractions. In addition, the AlF^+ beam was contaminated by a small amount of SiO . In the future, measures have to be taken to separate the Si and O from the Al and F ions in the detected beams to obtain better results.

Table 1. Observed equilibrium charge state fractions for neutral- ($f_{0,\infty}$) and negative-ion-formation ($f_{-1,\infty}$).

Primary ion beam	Energy	Charge-exchange medium	$f_{-1,\infty}$ [%]	$f_{0,\infty}$ [%]
As^+	25 keV	Mg	15	84
As^+	50 keV	Mg	13	86
As^+	25 keV	Cs	47	53
As^+	50 keV	Cs	34	66
AlF^+	40 keV	Mg	~15	~80
AlF^+	40 keV	Cs	~15	~80

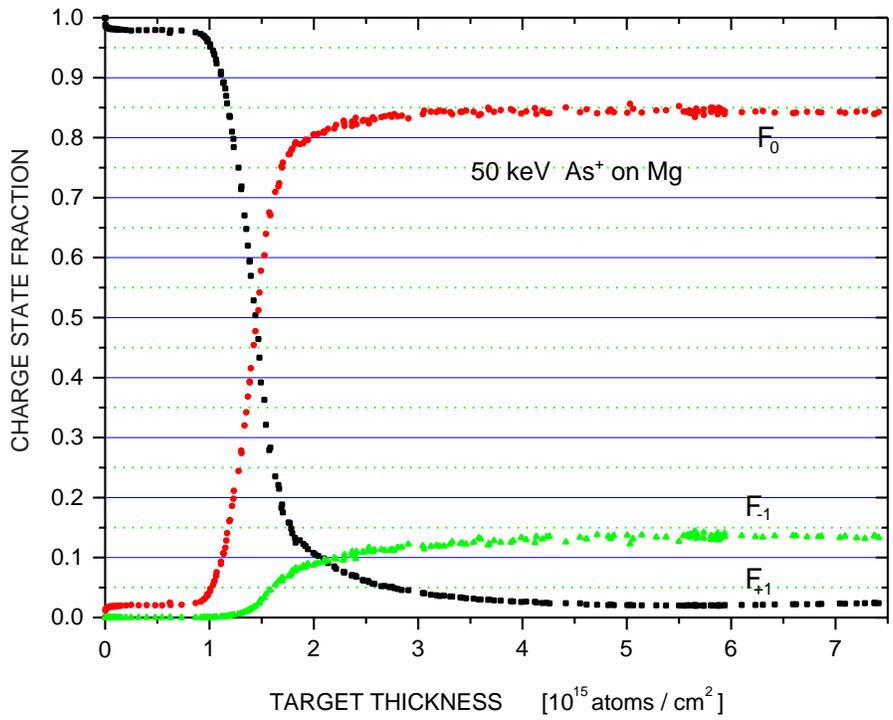


Fig. 1. Example of measured charge state fractions for a 50 keV As⁺ beam on Mg as a charge-exchange medium. F_{+1,0,-1} denotes the positive, neutral and negative charge state fractions, respectively.

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