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Quadrupole mass spectroscopy of neon

Dear Sir,

Introduction

Despite the widespread use of pure neon gas, no mass spectrum could be obtained from standard literature, e.g. the database of the National Institute of Standards and Technology.[1] The knowledge of the exact masses of the stable isotopes is, however, not sufficient for many applications. For example, using neon as probing gas for leak detection will suffer severely from likely water contamination, due to the natural occurrence of heavy water $H_2^{18}O$ at the approximately the same mass as the main neon isotope ^{20}Ne. Thus, neon isotopes like ^{22}Ne or twice ionized neon atoms $^{20}Ne^{2+}$ have to be used for the partial pressure determination. The measurements discussed in this letter will be quite helpful for these type of applications.

Experimental details

An ultra high vacuum apparatus with a base pressure of $5 \cdot 10^{-11}$ hPa, which has been described in detail in a preceding study,[2] is used to carry out the experiments. All measurements were performed at room temperature. Neon (Linde Gas, >99.999%) is offered via backfilling the chamber using a bakeable leak valve. The gas line is evacuated and can be heated in order to ensure cleanness. A quadrupole mass spectrometer with electron impact ionization and an electron multiplier (Balzers QMS 112 A) is used to analyse the gas composition with an overall integration time of 30 s per data point. During measurements, the partial pressure of the analysed neon gas has been chosen to be about 100 times as big as the total pressure of the residual gas. Additionally, a spectrum of the residual gas before neon dosage has been subtracted from the neon spectrum. All peak positions have been corrected according to the literature values of helium and oxygen.

Results and discussion

The resulting neon spectrum is depicted as ion current in 10^{-7} A *versus* mass in atomic units in **Fig. 1.** The inlay shows the complete spectrum up to 98 u, while the main part enlarges the region up to 45 u in detail. The main neon isotopes are found with approximately the fraction that has been claimed to be their natural distribution[3] at relative fraction of 0.29% ^{21}Ne and 9.35% ^{22}Ne with respect to the ^{20}Ne peak. Twice-ionized neon species are found at 2.50% with respect to the corresponding peaks from the single-ionized species. Residual argon is present with a fraction of 0.2% with respect to the main neon peak. Some remaining pollutants from the gas line are found, too, namely hydrogen, nitrogen, oxygen, nitrogen oxide, water, carbon oxides, acetylene and fluoromethane, as well as their corresponding natural isotopes and fragments from ionization. All peak positions and intensities are listed in **Table 1,** together with their correlation.

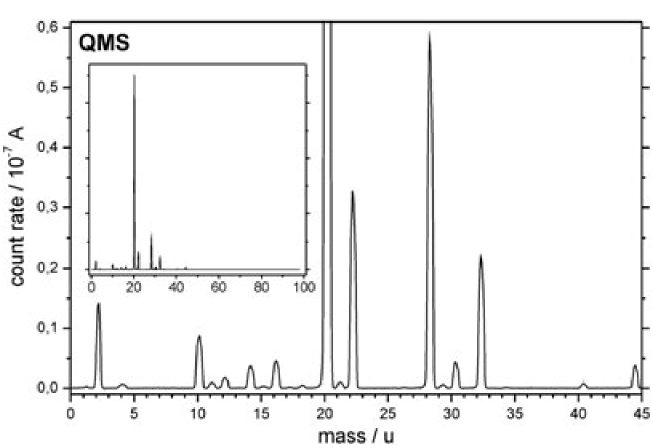

Figure 1. Quadrupole mass spectrum of neon.

Table 1. Peak positions, intensities and correlations

Mass/a.u.	Peak height	Relative intensity	Correlation
2.187	0.14107	**2.77**%	H_2
4.000	0.00625	**0.12**%	He
10.045	0.08754	**1.72**%	Ne^{2+}
11.043	0.00861	**0.17**%	$^{22}Ne^{2+}$
12.040	0.01802	**0.35**%	C
14.035	0.03709	**0.73**%	N
15.003	0.00295	**0.06**%	CH_3
16.030	0.04582	**0.90**%	O,CH_4
18.056	0.00478	**0.09**%	H_2O
19.990	3.50185	**68.83**%	Ne
20.987	0.01008	**0.20**%	^{21}Ne
21.985	0.32729	**6.43**%	^{22}Ne
26.066	0.00106	**0.02**%	Acetylene
28.000	0.58115	**11.42**%	N_2,CO
28.998	0.00569	**0.11**%	^{18}CO
29.995	0.04348	**0.85**%	NO
31.990	0.21931	**4.31**%	O_2
34.015	0.00113	**0.02**%	CH_3F
40.000	0.00710	**0.14**%	Ar
44.020	0.03732	**0.73**%	CO_2
-	0.00050	-	Noise level

Yours,

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References

[1] NIST Mass Spec Data Center, S. E. Stein, director. In "Mass Spectra", NIST Chemistry WebBook. NIST Standard Reference Database Number 69, P.J. Linstrom and W.G. Mallard (Eds). National Institute of Standards and Technology: Gaithersburg MD, 20899. http://webbook.nist.gov, (retrieved April 16, **2012**).

[2] M. Frerichs, F. Voigts, and W. Maus-Friedrichs, Fundamental processes of aluminium corrosion studied under ultra high vacuum conditions, *Appl. Surf. Sci. 253*, 950 (**2006**).

[3] G. Audi, O. Bersillon, J. Blachot, A.H. Wapstra, The Nubase evaluation of nuclear and decay properties, *Nucl. Phys. A 729*, 3 (**2003**).

