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LIGHT SOURCE FOR THE STUDY OF NEUTRAL GAS PRESSURE BROADENING

N. ŠIŠOVIĆ[1], I. VIDENOVIĆ[1], M. KURAICA[1], V. MILJEVIĆ[2] and N. KONJEVIĆ[1]
[1] *University of Belgrade, Faculty of Physics, P.O.Box 368, 11001 Belgrade, Yugoslavia*

[2] *Atomic Physics Laboratory, Institute "Vinča", P.O.Box 552, 11001 Belgrade, Yugoslavia*

Abstract. A discharge formed in a cylindrical coaxial diode with a cylindrical mesh cathode (CMCD) as new light source for the study of neutral gas pressure broadening is investigated. The pressure broadened profiles of two neon spectral lines emitted from low pressure CMCD glow dischrage have been studied using a Fabry-Perot interferometer.

1. INTRODUCTION

Spectroscopic study of neutral gas pressure broadened spectral lines at low pressures meets certain experimental problems related to the basic features of commonly used light sources. Standard sources for these studies are water-cooled capillary glow discharges (see e.g. Bielski and Wolnikowski, 1978) with relatively high current densities even in low discharge current regime. In this paper we describe new light source with transversal excitation and much lower current density. The results of the line shape studies of two neon spectral lines $\lambda = 585.25$ nm, $\lambda = 692.95$ nm in low pressure regime are reported.

2. EXPERIMENTAL

Our CMCD is shown in Fig 1. This type of glow discharge is first reported by Miljević in 1982 and used at lower pressures as magnetron light source. It consists of two coaxial electrodes : a cylindrical anode - CA (ID 18 mm × 80 mm), and a cylindrical mesh cathode - CMC (ID 5.5 mm, OD 7.5 mm × 110 mm). The mesh is manufactured of stainless steel wire (dia 0.4 mm), and has a transparency of about 60%. The diode is placed in a glass tube (Pyrex, dia 5 cm, long 50 cm). Quartz windows are mounted on ends of the tube to allow end-on glow discharge observations along optical axis. The countinous flow of the working gas - neon was sustained at pressure in the region $p = 266 - 931$ Pa by means of a needle valve and two stage mechanical vacuum pump. To run discharge a stabilized dc voltage power supply ($0 - 2$ kV, $0 - 100$ mA) was used. Ballast resistor $R = 10$ kΩ was placed in series with the discharge and power

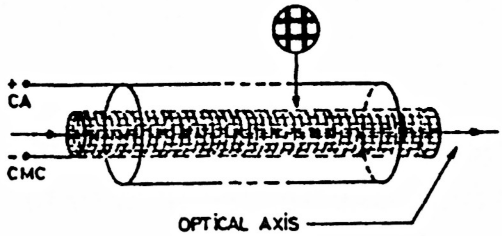

Fig. 1. Schematic diagram illustrating the CMCD.

supply. All measurements were performed at the discharge current $I = 20$ mA and voltage $U = 210$ V.

The light from CMDC was focused by achromatic lens (focal length $f = 15$ cm) onto front mirror of piezoelectrically-scanned Fabry-Perot interferometer (distance between mirrors $d = 12$ mm, $R = 0.875 - 0.980$, free spectral range $\Delta\lambda_S = 0.014 - 0.020$ nm), combined with 0.25 m grating monochromator-photomultiplier detection system. The signals from detection system were A/D converted, collected and processed by PC.

3. RESULTS AND DISCUSSION

Typical recorded line shape of neon spectral line $\lambda = 585.25$ nm is given in Fig.2. In the analysis of the profile, we have made assumption that the overall profile is convo-

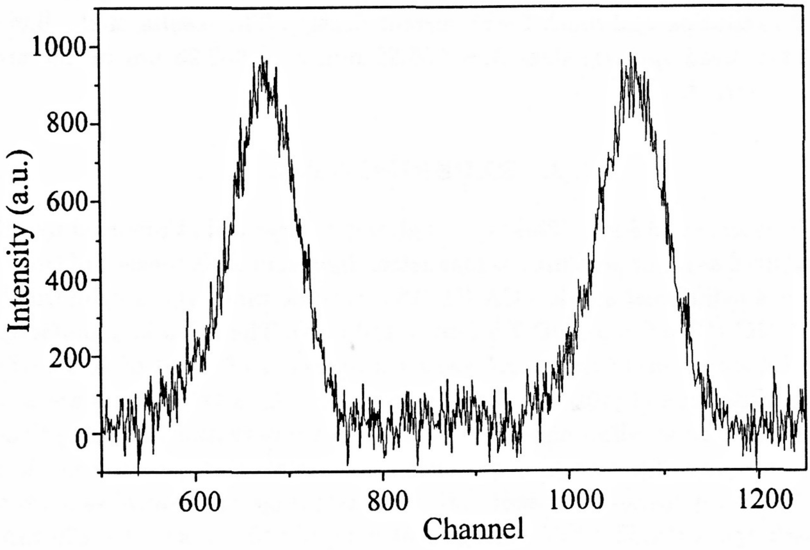

Fig. 2. Typical Fabry-Perot interferogram of NeI λ=585.25 nm at the pressure p=266 Pa.

lution of Airy's, apparatus function of Fabry-Perot interferometer, and Voigt profile. The Gaussian part of the Voigt profile gives the information about gas kinetic temperature of the discharge, while the Lorentzian fraction describes the pressure broadening of the spectral line. In the deconvolution procedure, we have followed the method of graphic deconvolution, described by Platiša *et al.* (1983). The results of such analysis are given in Figures 3. and 4.

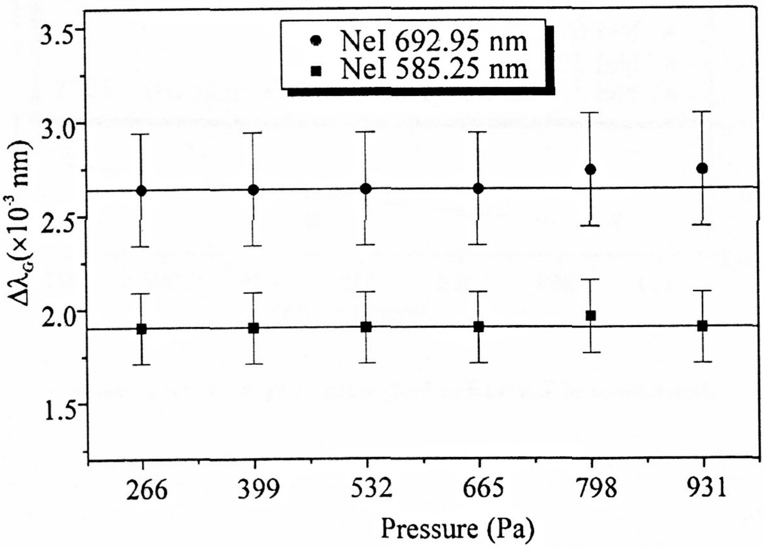

Fig. 3. Dependence of Gaussian half-width $\Delta\lambda_G$ vs. neon pressure.

As can be seen the Gauusian half-width is independent of the neon pressure. Gas temperatures derived from Gaussian part of line profiles are $T_G = (400 \pm 40)$K.

The half-widths of Lorentzian component of both spectral line profiles show the predicted linear dependence upon the neon pressure (Fig.4.).

For the line $\lambda = 585.25$ nm, we have obtained the simmilar value of pressure broadening coefficient, $\beta = 4.04$, in comparsion with that measured by Bielski and Wolnikowski (1978) ($\beta = 3.72$). Unfortunately, the half-widths of Lorentzian part are three times larger. At this moment we can not trace the cause for this large discrepancy.

Further experimental work is in progress and results will be reported at the Conference.

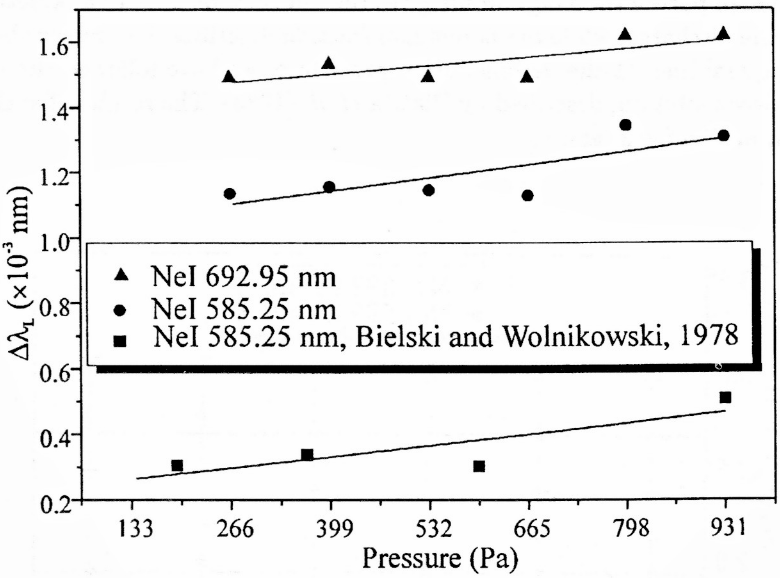

Fig. 4. Dependence of Lorentzian half-width $\Delta\lambda_L$ vs. neon pressure.

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