

Continual radiation of H_2 and D_2 ($a^3\Sigma_g^+ \rightarrow b^3\Sigma_u^+$) induced by electron impact

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Electron induced fluorescence apparatus (EIFA) was used for examination of hydrogen and deuterium excitation by electrons at 14 eV impact energy with subsequent emission in spectral region between 200 – 700 nm. Relative excitation cross section for electrons with energy 0 – 100 eV was measured and compared at two separate wavelengths – 650 nm and 230 nm to confirm the radiation originates from the same deexcitation transition. The radiation of the continuum at wavelengths higher than 500 nm is shown for the first time in experimental studies. Deuterium spectral measurement was performed also at electron energy 14 eV in order to compare the results with hydrogen molecule observation.

1. Introduction

Motivation for this research is the application of the results in diagnostic of thermonuclear plasmas in tokamaks [1]. Hydrogen and deuterium plasma is produced in tokamak vessels, and the interaction of H_2 and D_2 molecules with low energy electrons (0 – 100 eV) is particularly important at the plasma edge.

2. Experiment

Hydrogen molecule has been examined in detail on EIFA. Spectra on several electron impact energies were obtained. In this work we present the spectrum at 14 eV (Figure 1) where only the continual radiation originating from the fluorescence transition H_2 ($a^3\Sigma_g^+ \rightarrow b^3\Sigma_u^+$) is observable. The spectrum was obtained with 0.4 nm optical resolution and it is given in relative scale dependent on the pressure inside the vacuum chamber ($\sim 10^{-4}$ mbar for H_2 measurements).

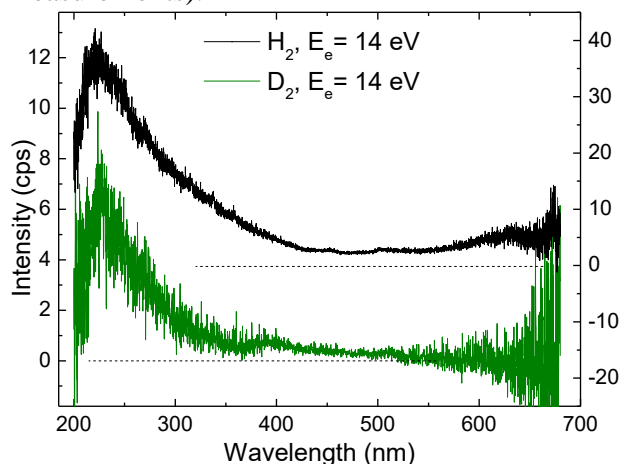


Figure 1. Emission spectrum of H_2 and D_2 at 14 eV electron impact energy originating from H_2 (black) and D_2

(green) ($a^3\Sigma_g^+ \rightarrow b^3\Sigma_u^+$) radiative transitions. The spectra were corrected for spectral response of the apparatus.

Deuterium spectrum at 14 eV was obtained for the comparison. The pressure in the reaction chamber during the D_2 measurements was slightly lower than the H_2 measurement ($\sim 5 \times 10^{-5}$ mbar) which explains the lower signal – to – noise ratio in D_2 spectrum. In D_2 spectrum only the radiation of continuum is present, as well.

The second mode of measurement at EIFA is the excitation cross section measurement at fixed wavelength. The cross sections were measured at 230 nm and 650 nm. According to their identical shape and the threshold energies corresponding to 12.3 ± 0.5 eV it is possible to suggest that both correspond to the bound – to – unbound transition, continuum radiation of H_2 ($a^3\Sigma_g^+ \rightarrow b^3\Sigma_u^+$).

3. Acknowledgements

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4. References

[1] U. Fantz et al. Plasma. Phys. Contr. F. **43** (2001) 907.