Spectroscopic observations of the hydrogen and tungsten hydride molecules in divertor plasma – isotope effect

Ewa Pawelec[1], Sebastijan Brezinsek[2], Mathias Groth[3], Alexander Huber[2], Andrew Meigs[4], M18-27 team, M18-18 team and JET contributors*

[1]University of Opole, Opole, Poland,
[2]Forschungszentrum Jülich GmbH, Institute for Energy and Climate Research Plasma Physics, Jülich, Germany,
[3]Aalto University, Espoo, Finland
[4]CCFE, Culham Science Centre, Abingdon, United Kingdom

Last campaigns in JET concentrated on isotope effects – there were (light) hydrogen, deuterium and tritium campaigns, with many pulses of mixed isotope plasmas, including current campaign in deuterium-tritium mixture. This situation made possible observations of hydrogen molecules with varying isotopic composition – H_2, HD, HT, D_2, T_2 and DT Fulcher band spectra were recorded during those experiments and their lines can be identified in the recorded spectra. Problems with analyses of those spectra are:

- complexity of the Fulcher band spectra in themselves
- fact, that for the isotopic mixtures the recorded spectrum consists of overlapping spectra of two "pure" and one "mixed" molecules, complicating the analysis enormously
- fact, that for some of those molecules, especially DT, there are next to no molecular data in literature.

This contribution presents which of the isotopic versions of hydrogenic molecules and spectra can be identified in the visible-region spectra of divertor plasma and how the available transition data fit the experimental results.

In the regions where plasma is touching the tungsten-covered plasma vessel we expect also observation of the tungsten hydride molecules, created during chemically-assisted physical sputtering. Spectra of those at ~675 nm was reportedly recorded in hydrogen and deuterium plasmas containing tungsten, and spectra in appropriate regions were reported also in deuterium fusion plasmas in TEXTOR, ASDEX and JET. Here we present spectra from this wavelength region recorded in different isotope fusion plasmas – from hydrogen to tritium. For those molecules, diatomic data for WT are absent; and in the case of WH and WD our results do not completely agree with existing sparse diatomic constants, which shows the importance of providing a theoretical input into this problem.

* See the list of authors of E. Joffrin et al, Nucl. Fusion 59 (2019) 112021 and J. Mailloux et al to be published