

Contents

1	Introduction	6
2	Basics of deuterium retention in metals	10
2.1	Diffusion and trapping of deuterium in tungsten	10
2.2	Exposure parameters influencing the deuterium retention	13
2.3	Helium and argon effects on deuterium retention	14
3	Experimental setup	17
3.1	Linear plasma generator PSI-2	17
3.2	Langmuir probe	21
3.3	Optical emission spectroscopy	23
3.4	Target manipulators	29
3.5	Thermal desorption spectroscopy	33
4	Experimental results	37
4.1	Plasma characterization by optical emission spectroscopy	37
4.1.1	Electron density: Balmer line ratios	37
4.1.2	Electron density: Fulcher band lines	40
4.1.3	Electron density: Paschen line Stark broadening	43
4.1.4	Electron temperature: Paschen lines ratio	46
4.1.5	Argon ion concentration	48
4.1.6	Helium ion concentration	54
4.2	Studies of deuterium retention in tungsten	61
4.2.1	Surface modifications	63
4.2.2	Deuterium retention with plasma impurities	68
4.2.3	Deuterium retention with variation of ion fluence	72
4.3	Studies of deuterium retention and erosion of aluminium and beryllium	74
4.3.1	Surface modifications	76
4.3.2	Sputter yields	84
4.3.3	Deuterium retention	88
5	Modelling of deuterium diffusion in metals	92
5.1	Influence of helium nanobubbles	100
5.2	Implementation of argon-induced defects	104
5.3	Fluence dependency	106

6	Conclusions	111
7	Appendix I: Diffusion simulation MATLAB code	117
8	References	124
9	List of figures	134