Abstract

Magnetic fusion energy is a promising next generation source of electricity. The choice of plasma-facing components (PFCs) is a key engineering challenge in fusion reactor design since the interactions between plasma and PFCs are directly related to fuel lost, safety, and wall recovery issues. Carbon, beryllium, and tungsten have been chosen to be the primary materials in the International Thermonuclear Experimental Reactor (ITER). Tungsten has become an essential material in fusion reactor design because of its low erosion yield and high melting point. Therefore, hydrogen isotopes retention and migration in tungsten has transpired into an important safety issue. Consequently, transport and trapping properties of hydrogen isotopes in tungsten is crucial and need further understanding.

To accurately estimate hydrogen isotope retention and recovery in tungsten (current leading candidate for PFC), we have developed a robust model that has recently been benchmarked against isotope depth profile and retention level in tungsten target under various conditions and compared with both experimental data and simulation results. In this work, a system of partial differential
equations describing deuterium behavior in tungsten under various conditions is solved numerically to explain recent data compared to other methods. The developed model of hydrogen retention in metals includes classic, intercrystalline and trapped-induced Gorsky effects. The bombardment and depth profile of 200 eV deuterium in single crystal tungsten are simulated and compared with recent work. The total deuterium retention at various temperatures and fluences are also calculated and compared with available data. The results are in reasonable agreement with data and therefore, one can use this model to reliably estimate hydrogen isotope retention behavior in tungsten and potential other PFC candidates, during normal operational pulse, effects of edge-localized modes (ELMs) and during cleaning processes.

About the Speaker

Dr. Alice Hu is a Research Assistant in Center for Materials Under eXtreme Environments (CMUXE) at Purdue University. She received her Ph.D. and M.S. degrees from Nuclear Engineering Department of Purdue University in 2014 and 2011 respectively, and her B.S. degree from Physics Department of National Taiwan University in 2009. Her research interests include numerical modeling for hydrogen isotopes behavior in plasma-facing components, molecular dynamics study in radiation damage on fission reactor material, and Monde Carlo calculation for rough surface sputtering yield.

All are welcome!
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