Lithium Vapor Shielding Formation In A Neutral Seeded Environment

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One of the biggest challenges along the road of fusion is dealing with the large heat and particle fluxes that inevitably find their way to the first wall. With no solid materials on earth able to withstand the high heat and particle fluxes of fusion plasmas, more attention is being given to liquid metals, mainly lithium. With its low atomic number of $Z=3$ and low melting temperature of $\approx 180^\circ C$, lithium is a promising candidate that not only reduces the energy losses of the plasma but was also proven to be beneficial to plasma performance \cite{1,2,3}. Recently, with the emergence of the national liquid metal program in the US led by the Oak Ridge National Lab (ORNL), the Princeton Plasma Physics Laboratory (PPPL) and the University of Illinois at Urbana-Champaign (UIUC), new efforts are being put towards the development of a fully liquid lithium divertor module for a Fusion National Science Facility (FNSF) \cite{4,5}. One of the big unknowns that need to be addressed has to do with the lithium vapor shielding that will form in a neutral seeded environment. Indeed, with heat fluxes in the divertor regions expected around 100 MW \cite{4}, gas seeding is necessary to diffuse the energy and reduce the heat flux to the divertor to around 30 MW. The formation of the vapor shield in this seeded environment is not understood properly and is the subject of the following presentation. To this end, a lithium volume will be exposed to a hydrogen plasma from a Helicon source at the Center for Plasma-Material Interactions (CPMI) at UIUC, in a controlled environment. The lithium vapor shielding is to be observed in various temperature and pressure conditions with and without bleeding Neon above the lithium volume. This will help in analyzing the radiating power of the vapor shielding in the presence and absence of neutral seeding. These first results will also help in integrating the vapor shielding phenomenon into a computational code to better predict and study the physics of vapor shielding for future experiments. More advanced and complex environments are planned to be studied in a second experimental campaign on larger devices such as the classical stellarator HIDRA \cite{6} at CPMI.