TOPIC: EX-D

Synergy between the "Snowflake" Divertor Configuration and Lithium Plasma-Facing Component Coatings in NSTX

Soukhanovskii, V. A

Lawrence Livermore National Laboratory, Livermore, CA, USA

vlad@llnl.gov

The studies of an innovative "snowflake" divertor configuration and evaporated lithium wall and divertor coatings in the National Spherical Torus Experiment (NSTX) provide support to these PMI concepts as viable candidates for future high divertor heat flux tokamaks and spherical tokamak based devices for fusion development applications. Lithium coatings have enabled ion density reduction up to 50 % in NSTX through the reduction of wall and divertor recycling rates. The outer SOL transport regime changed from the high-recycling, heat flux conduction-limited with $\nu_e^* \sim 10\text{-}40$ to the sheath-limited regime with a small parallel T_e gradient and higher SOL T_e with $\nu_e^* < 5\text{-}10$. A recycling coefficient of R~0.85 was inferred from interpretive two dimensional multifluid edge transport modeling. However, a concomitant elimination of ELMs and an improvement in particle confinement caused impurity accumulations. The "snowflake" divertor (SFD) configuration obtained in NSTX in 1 MA 4-6 MW NBI-heated H-mode lithium-assisted discharges demonstrated encouraging impurity control and divertor heat flux handling results. In NSTX experiments many theoretically predicted geometric and radiative properties of the SFD configuration have been confirmed. A very high poloidal flux (area) expansion of the separatrix region in the SFD, as well as a longer connection length, as compared to a standard divertor configuration, led to a partial strike point detachment and an associated peak heat flux reduction. The core carbon density and radiated power were also significantly reduced. This work was performed under the auspices of the U.S. Department of Energy in part under Contract DE-AC52-07NA27344.