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EX/P5-27: The Effects of Increasing Lithium Deposition on the Power Exhaust Channel in NSTX

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Previous measurements on the National Spherical Torus Experiment (NSTX) demonstrated peak, perpendicular heat fluxes, qdep, pk ≤ 15 MW/m2 with an inter-ELM integral heat flux width, λq, int ˜ 3—7 mm during high performance, high power operation (plasma current, Ip = 1.2 MA and injected neutral beam power, PNBI = 6 MW) when magnetically mapped to the outer midplane. Analysis indicates that λq, int scales approximately as Ip-1[1]. The extrapolation of the divertor heat flux and λq for NSTX-U are predicted to be upwards of 24 MW/m2 and 3 mm respectively assuming a high magnetic flux expansion, fexp ˜ 30, PNBI = 10 MW, balance double null operation and boronized wall conditioning.
While the divertor heat flux has been shown to be mitigated through increased magnetic flux expansion[1], impurity gas puffing[2], and innovative divertor configurations[3] on NSTX, the application of evaporative lithium coatings in NSTX has shown reduced peak heat flux from 5 to 2 MW/m2 during similar operation with 150 and 300 mg of pre-discharge lithium evaporation respectively. Measurement of divertor surface temperatures in lithiated NSTX discharges is achieved with a unique dual-band IR thermography system[4,5] to mitigate the variable surface emissivity introduced by evaporative lithium coatings. This results in a relative increase divertor radiation as measured by the divertor bolometry system. SOLPS[6] modeling of heavy lithium evaporation discharges will be presented to elucidate divertor operation in this scenario. While the measure divertor heat flux is reduced with heavy lithium evaporation, λq contracts to 3—6 mm at low Ip but remains constant as Ip is increased to 1.2 MA yieldingλq's comparable to no lithium discharges at high Ip. Implications for NSTX-U operation with heavy lithium coatings in the divertor will be discussed.

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[3] V.A. Soukhanovskii, et al., Nucl. Fusion 51 (2010) 012001
[4] J-W. Ahn, et. al., Rev. Sci. Instrum. 81 (2010) 023501
[5] A.G. McLean, et al., submitted to Rev. Sci. Instrum. (2011)
[6] J.M. Canik, et al., Phys. Plasmas 18 (2011) 056118

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