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Surface Science Station ($S^3$): a real-time diagnostic of boronization in Alcator C-Mod

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The recently installed Surface Science Station ($S^3$) was used to study the effectiveness of boronization utilizing electron cyclotron discharge (ECD) plasmas (90% He 10% D$_2$B$_6$) in Alcator C-Mod. The boron (B) deposition was measured in real time with a pair of quartz microbalances (QMBs) the faces of which were oriented parallel and perpendicular to the applied magnetic field. A maximum B deposition rate of $\sim 2.5$ nm/min was measured on both QMBs for a chamber pressure of 15 mTorr. The peak deposition took place $\sim 10$ cm outboard from the EC resonance. Decreasing the D$_2$B$_6$ throughput (pressure) decreased the B deposition rate, again for both QMBs. Overall, the evidence points to the B deposition being primarily ionic and that B ion Larmor radius effects lead to B deposition on surfaces parallel to the magnetic field (implying B ion temperatures in the range of 10-15 eV). Subsequent application of He-only ECDs showed evidence of the B layers being eroded & redeposited by the plasma with rates 10x lower on the QMB face parallel to the magnetic field compared to the QMB face perpendicular to the field.

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