**Differentiating the role of lithium and oxygen in retaining deuterium on lithiated plasma-facing components**

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Outline

1. Motivation
    a. Lithium wall conditioning improves plasma performance, in part, by enhancing deuterium retention.
    b. Fundamental understanding of how lithium improves retention can be used to improve its application and applicability to other systems.
2. Results
    a. X-ray photoelectron spectroscopy immediately identifies oxygen as a prominent constituent.
        i. Oxygen concentration in lithiated graphite increases from ~8% to ~20% over the course of 100 hours sitting in UHV ($10^{-10}$ mbar).
        ii. Oxygen concentration increases to ~20% during a 1 minute deuterium ion irradiation ($3.9 \times 10^{15}$ $cm^{-2}$).
    b. Connection to theory.
        i. DFT simulations compare graphite matrices with and without oxygen and lithium, and reveal that deuterium preferentially binds with oxygen instead of lithium.
        ii. Simulations suggest that greater retention occurs with high amounts of oxygen (~20%) and no lithium.
    c. In experiments, oxygen was implanted in graphite to achieved ~20% surface concentration. Subsequent deuterium implantation released all of the implanted oxygen, thus precluding enhanced retention.
3. Conclusions
    a. Oxygen-deuterium binding is the primary mechanism for enhanced deuterium retention in lithiated graphite.
    b. Lithium plays an indispensible role of gettering and retaining oxygen.
4. Future work
    a. As oxygen plays a critical role in retaining deuterium, determine the relative contribution of potential oxygen sources: 1) ambience, 2) substrate, 3) lithium deposit.

Useful PPPL contributions

1. Provide the RGA data from a ‘typical’ run. How does the oxygen behave during lithium evaporation? During shot?