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Charge exchange recombination spectroscopy of Ta^{q+} for application to DIII-D and ITER neutral hydrogen beam diagnostics

P. N. Yaron [1]

Flinders University, Institute for NanoScale Science and Technology
Bedford Park, South Australia

Tantalum has shown promise as a potential plasma facing material, due to its similar physical and chemical properties to Tungsten with the added ability to remove neutral Hydrogen atoms in the plasma edge. Reducing the number of charge exchange events reduces net energy losses in the plasma, potentially improving performance of fusion for energy devices. Cold spray deposited coatings of Tantalum on 316L steel have been developed at the University of Wisconsin, Madison. Initial experimentation has shown 'excellent structural stability'[1].

This work seeks to validate reduced charge exchange events using theoretical modelling of charge exchange recombination spectroscopy (CXRS). The model will be based on interactions of neutral beams at DIII-D [2] where further *in-situ* experimentation will most likely be performed using the Divertor Material Evaluation System (DiMES) [3]. The model will be extended to ITER diagnostic and heating beam conditions. A CR model will developed closely following the methodologies outlined previously by Ralchenko et. al. [4].

[1] M. Ialovega et al. Phys. Scr. **98,** 115611 (2023).
[2] 'DIII-D National Fusion Program Five-Year Plan 2019 – 2024' GA Report-A28765 (2018).
[3] D.L. Rudakov Fusion Engineering and Design **124**, 196–201 (2017).
[4] Dipti et al. Plasma Phys. Control. Fusion **63** 115010 (2021).