In Situ Characterization of Thin Film Molybdenum Carbide Using Spectroscopic Ellipsometry

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Molybdenum carbide (MoC_X) is an extremely hard transition metal carbide with demonstrated super conductive behavior. Thin film, two-dimensional (2D) molybdenum carbide in a synthesized state with a surface termination group called MXenes has been shown to exhibit either conducting or semiconducting properties and has been identified as a potential thermoelectric material. Synthesis and de-lamination techniques have been demonstrated for 2D Mo_2C by Hamlin *et al*.[1]

In this work we characterize the growth mechanism for depositing the first few cycles of plasma enhanced atomic layer deposition (PE-ALD) MoC_X film with the goal of achieving atomically thin continuous MoC_X. PE-ALD grown MoC_X has been demonstrated using $(^tBuN)_2(NMe_2)_2Mo$ with H_2 plasma at 150 °C.[2] This deposition technique will be explored in greater detail using real time *in situ* spectroscopic ellipsometry (SE) with a wavelength range from 245 to 990 nm. The nucleation and initial film growth rates can be measured through each PE-ALD half cycle reaction to determine and evaluate the mechanism of growth occurring at the film to substrate interface.

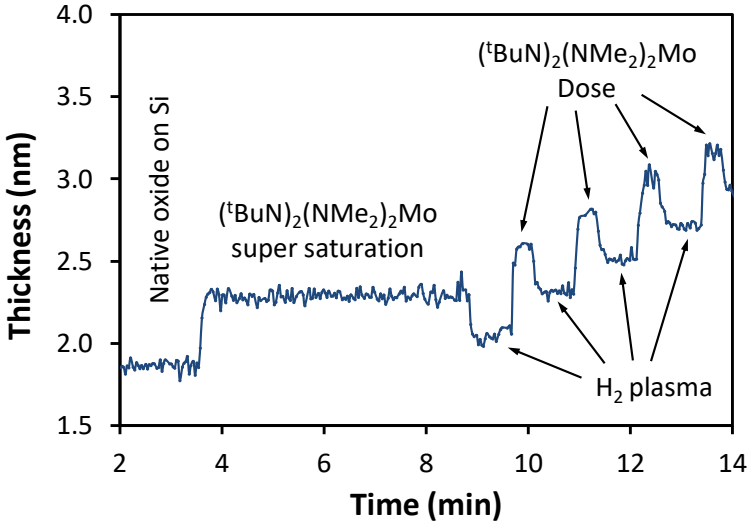

Figure 1. Spectroscopic ellipsometry of the first 4 cycles of PE-ALD grown MoC_X at 150 °C on native silicon dioxide.

References

[1]J. Hamlin et al., Adv. Funct. Mater. **26,** 3118 (2016).

[2]A. Bertuch, B Keller, N. Ferralis, J. C. Grossman, and G. Sundaram, J. Vac. Sci. Technol. A **35,** 01B141 (2017).