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Contribution ID: **3822** Type: **Oral Competition (Graduate Student) / Compétition orale (Étudiant(e) du 2e ou 3e cycle)**

(G*) High vacuum remote plasma vapour deposition of few-layer tungsten semi-carbide

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High quality, uniform thin films of quantum materials are of extreme importance across many classes of device research. Minimizing energy consumption, while keeping flexibility in the deposition process, along with high structural stability, electrical and thermal conductivity, and optical transparency is critical in designing a reactor for quantum material thin film growth. Ultra-thin films based on tungsten semi-carbide (W2C) are excellent candidates as quantum materials with startling properties such as theoretically predicted negative Poisson's ratio.[1] However, chemical-vapour thin-film deposition (CVD) techniques have not been reported to yield bona fide W2C films, arguably because they operate under thermodynamic equilibrium conditions, where the stable phases are segregated tungsten and carbon, or the carbon-rich WC. Here, we report of the synthesis of highly crystalline few-layer W2C, achieved using an ad-hoc designed remote plasma vapour deposition (RPVD) ultra-high vacuum reactor. The reactor built by us for this study generates tungsten ions from a 13.56 MHz radio frequency biased 2"target inductively coupled with hydrocarbon species from the ionisation of methane at ˜10-6 mbar (˜10-9 mbar base vacuum). The so achieved plasma is injected in a high-temperature furnace (900oC) where substrates are placed, by a 10-kV DC accelerating voltage. X-ray diffractometry, scanning tunneling microscopy, and elemental analysis have confirmed few-layer W2C crystals in the deposits, with decreasing thickness in backstream mode deposition, with the addition of varying amounts of Ar ions in the forward gas stream. Dramatic advantages of our high-vacuum RPVD deposition system rests in the high crystallinity of our deposits, where tungsten carbides without W2C structure (i.e. WC, or amorphous) were obtained by CVD or less advanced plasma deposition systems.[2]

[1] Wu et al, Phys. Chem. Chem. Phys., 2018, 20, 18924

[2] Baklanov et al, Mater. Res. Express, 2020, 9, 016403

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Keyword-2

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Keyword-3

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