Tech Highlight

Next generation semiconductor devices

A team of multidisciplinary researchers from IMRE, NUS and the Indian Institute of Science Education and Research, have come up with a technique to produce and increase the growth of high quality molybdenum disulfide (MoS_2), a 2D semiconductor. The augmented growth process to produce a MoS_2 single layer across a quarter 2-inch area could lead to a relatively scaled-up commercial production of enhanced MoS_2 films with a larger area, for further applications in flexible electronics.

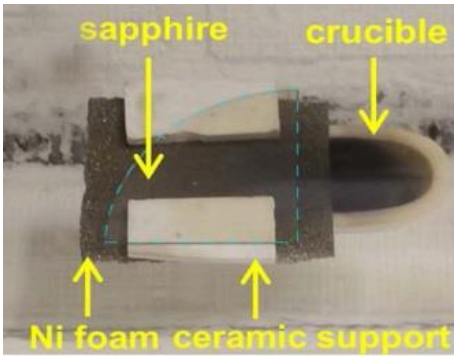
MoS_2 layers are ultra-thin, highly flexible and its function properties such as facilitating low current leakage are attractive active materials in various electronic, optical and quantum computing applications.

The project team, including IMRE scientists, Dr. Lim Yee Fun, Dr. Chi Dongzhi and Dr. Wong Swee Liang, used a nickel oxide (NiO) foam diffusion barrier that reacts and traps the chemical precursors, reducing the vapour phase concentrations of the reactants. This enabled favourable growth conditions over a larger area, thus, achieving a homogenous single layer MoS_2 growth across a quarter 2-inch sapphire wafer about 70% of the time. The results also indicated the successful growth of a highly crystalline and well-oriented MoS_2 monolayer.

Given the inherent flexibility of 2D materials such as MoS_2 films, the team also fabricated a field effect transistor device with good mobility of electron carriers. When tested, the device demonstrated low current leakage when it was in the 'off' state and high current activity when it was in the 'on' state pointing to the possibility of producing devices with low power consumption. The team hopes to extend the application to wearable devices as well. Currently, the IMRE members are collaborating with NUS researchers to build electronic circuits on MoS_2 films, where low electrical leakages are favoured.

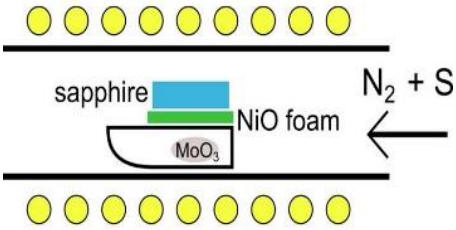
For more information, please contact Dr. Lim Yee Fun (limyf@imre.a-star.edu.sg)

The results of this research were published in ACS Nano, entitled "Modification of Vapour Phase Concentrations in MoS_2 Growth Using a NiO Foam Barrier".



Actual layout of crucible, substrate and NiO foam used during chemical vapor deposition (CVD) growth of MoS2.

Reference: ACS Nano 2018, 12, 2, 1339-1349



CVD deposition was carried out in a single zone 3-inch quartz tube furnace at atmospheric pressure. This is a schematic side view showing the relative positions of the different precursors and substrate in the tube furnace.

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