Growing 2D Transition Metal Dichalcogenides

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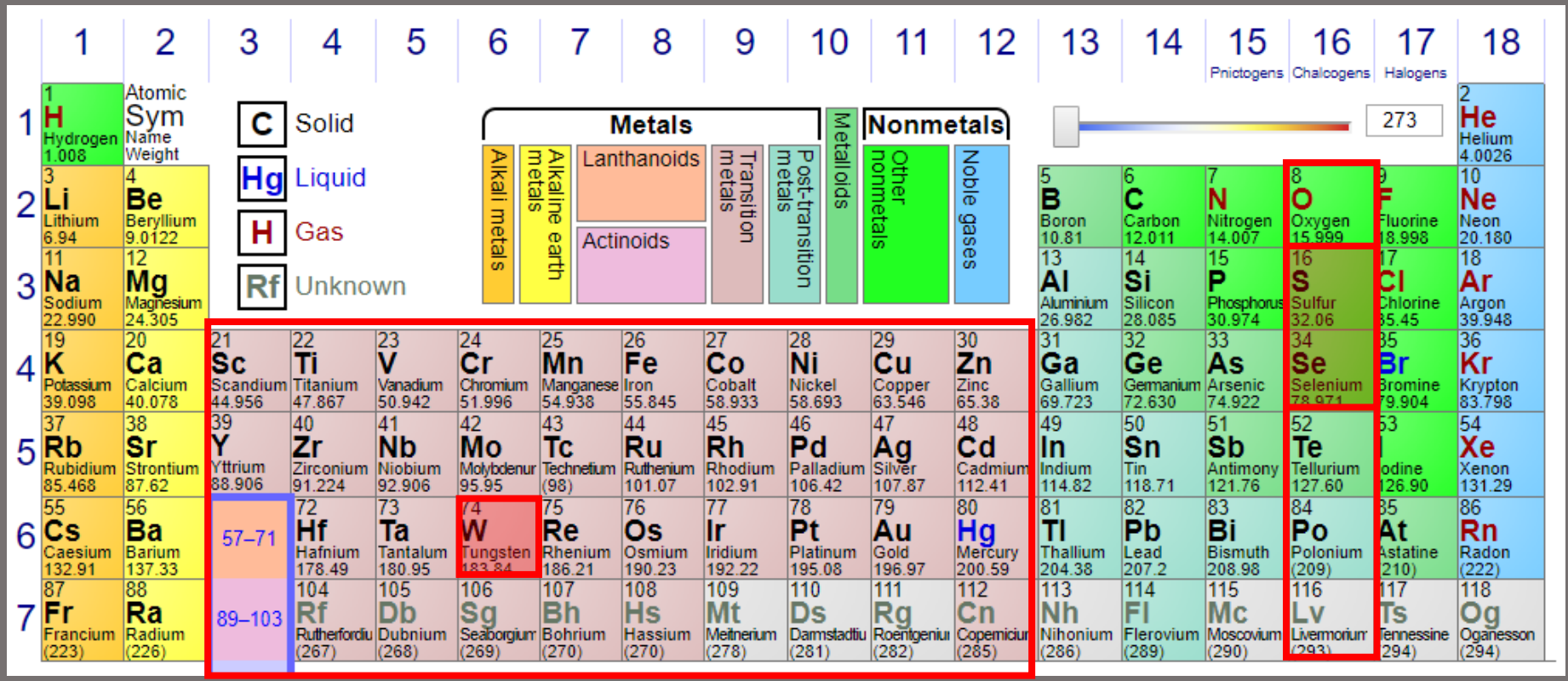
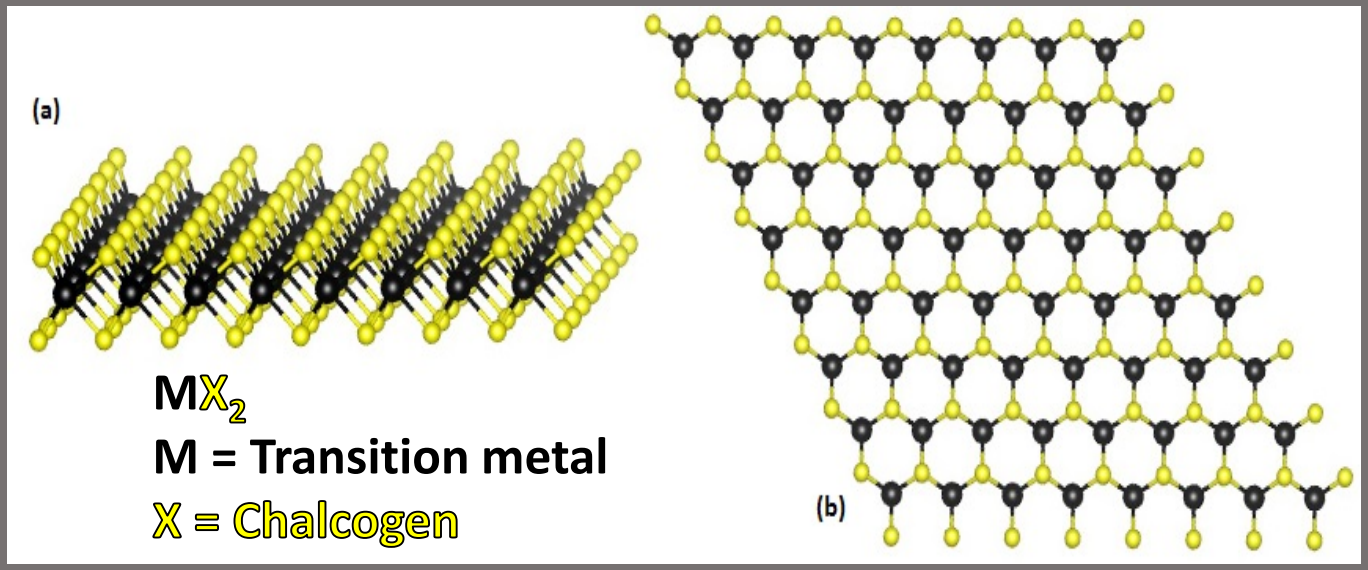


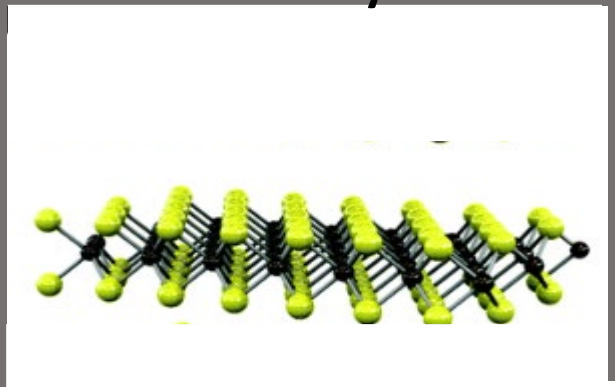


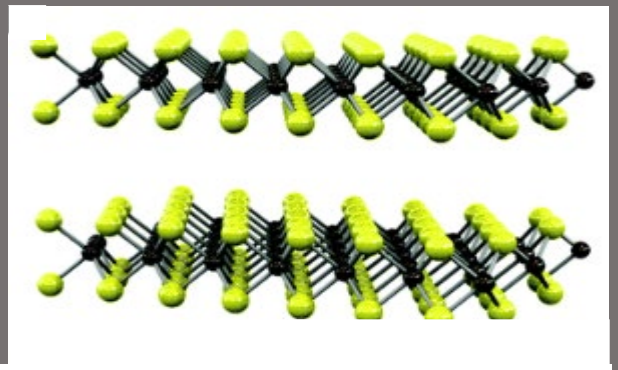
https://www.ptable.com/

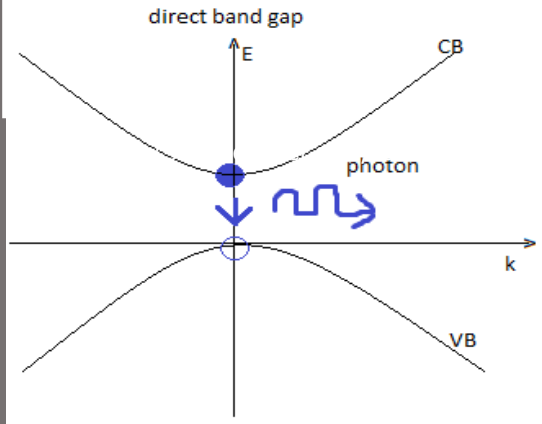
https://smc-datachallenge.ornl.gov/challenge-3-2017/

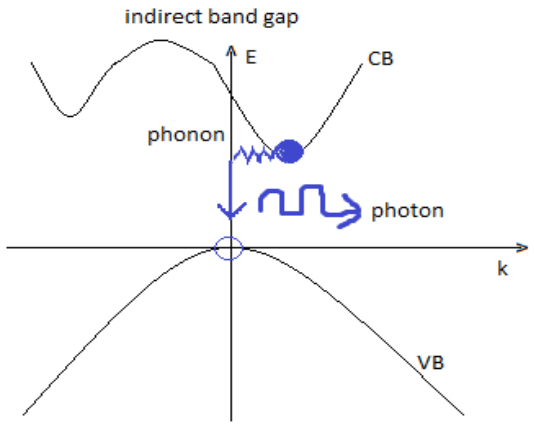
Monolayer

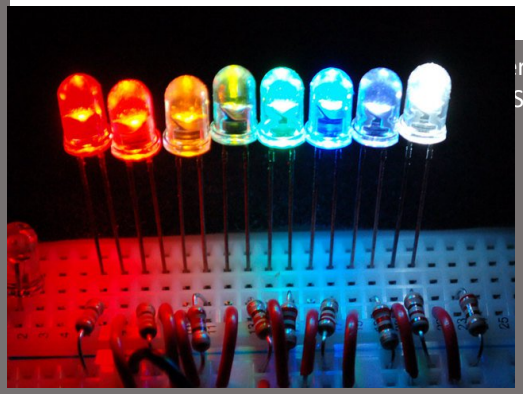
Bulk











rials_Science/S
Semiconductor

https://learn.adafruit.com/all-about-leds/what-is-an-led

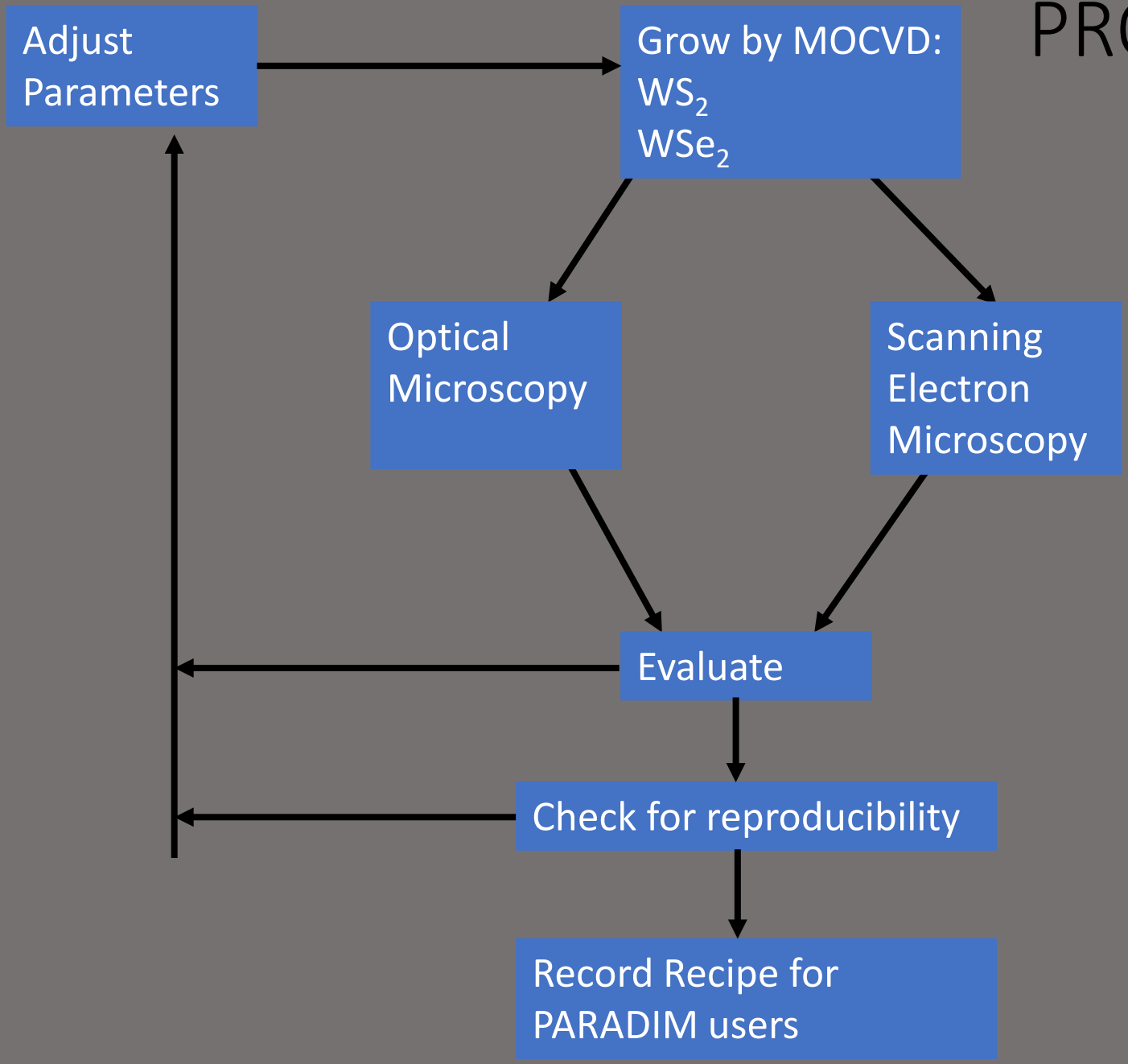
Group II	Group III	Group IV	Group V	Group VI
	B Boron 5	C Carbon 6	N Nitrogen 7	O Oxygen 8
Mg Magnesium 12	Al Aluminium 13	Si Silicon 14	P Phosphorus 15	S Sulphur 16
Zn Zinc 30	Ga Gallium 31	Ge Germanium 32	As Arsenic 33	Se Selenium 34
Cd Cadmium 48	In Indium 49	Sn Tin 50	Sb Antimony 51	Te Tellurium 52
Hg Mercury 80	Tl Thallium 81			

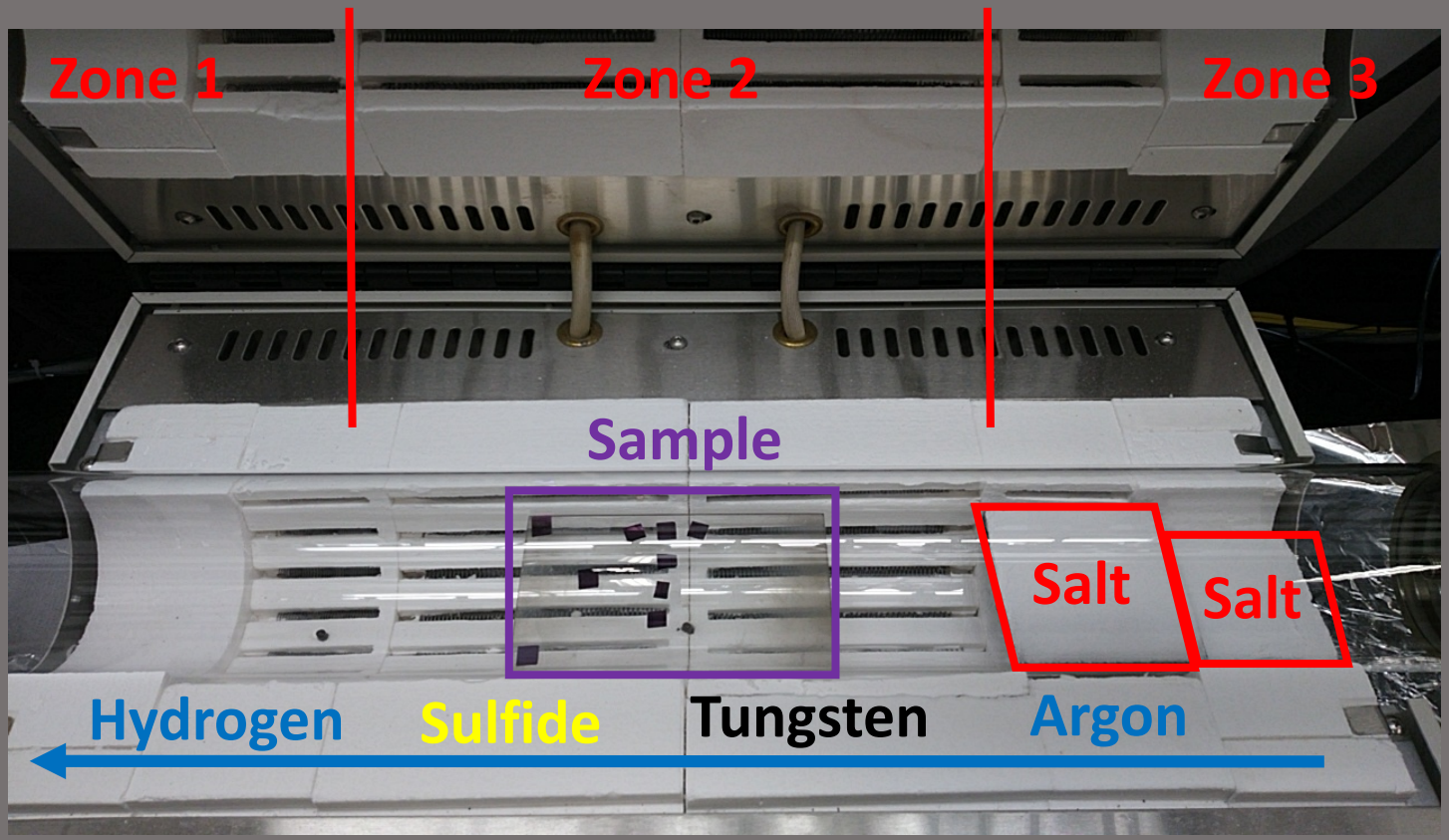
III–V

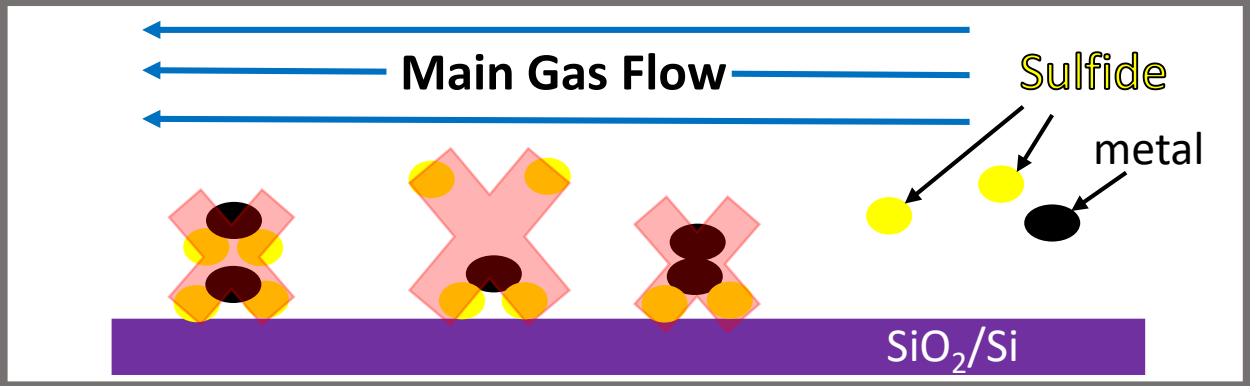
II–VI

http://www.iue.tuwien.ac.at/phd/palankovski/node18.html

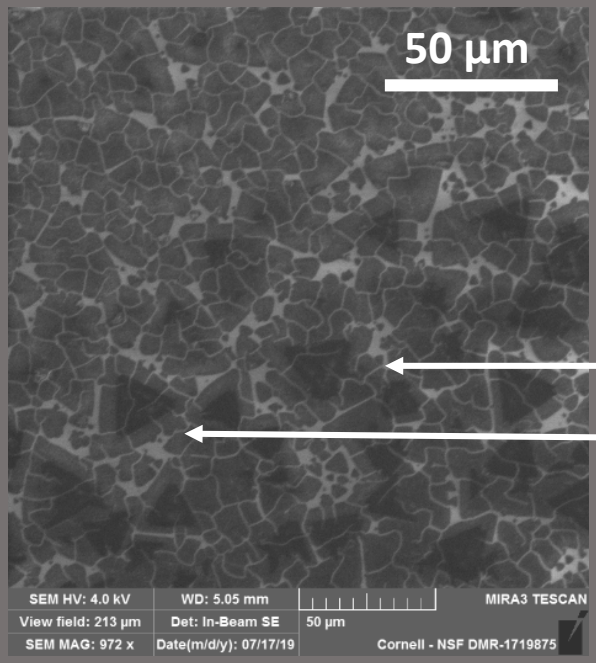
PROCEDURE


Adjust Parameters
Grow by MOCVD: WS_2 WSe_2
Optical Microscopy
Scanning Electron Microscopy
Evaluate
Check for reproducibility
Record Recipe for PARADIM users


Zone 1
Zone 2
Zone 3
Sample
Salt
Salt
Hydrogen
Sulfide
Tungsten
Argon


Main Gas Flow
Sulfide
metal
SiO2/Si

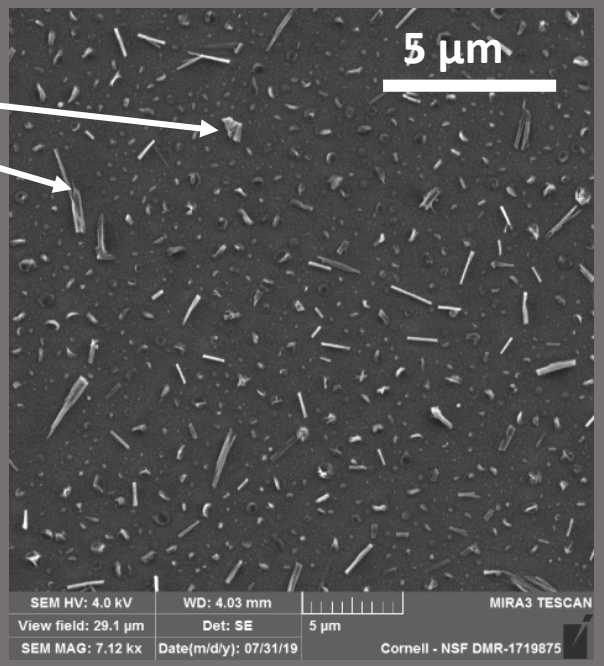
High sulfide ratio



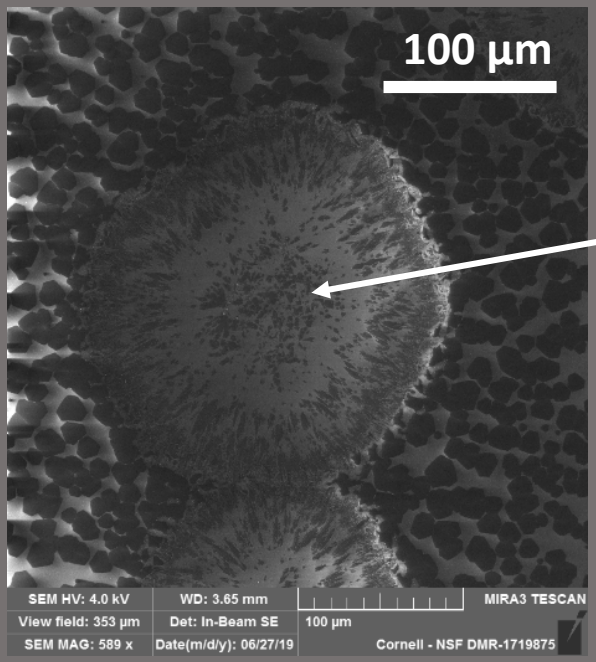
Multilayered growth

low sulfide ratio

Metal accumulations



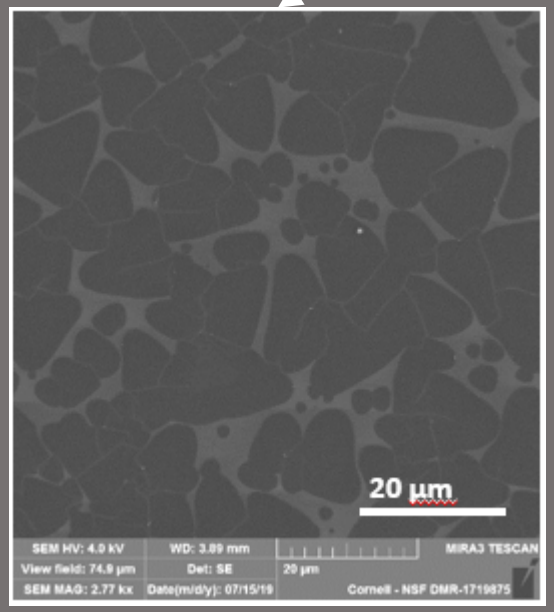
Salt plates too close



Salt grain craters

REPRODUCIBLE RESULTS

Higher than 90% coverage,
Grain sizes are ~ 10 µm



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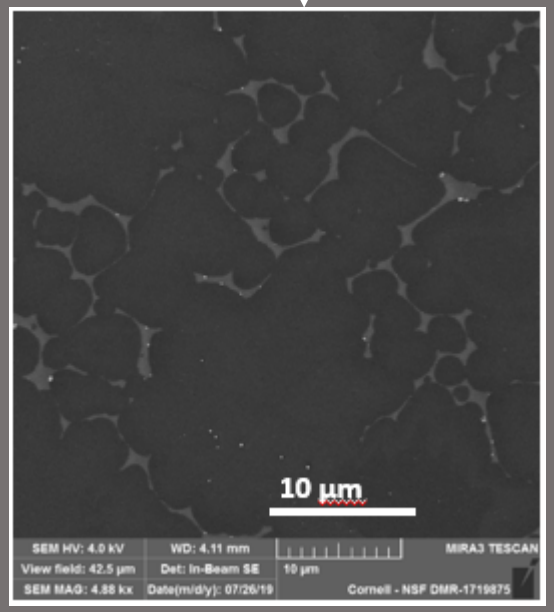

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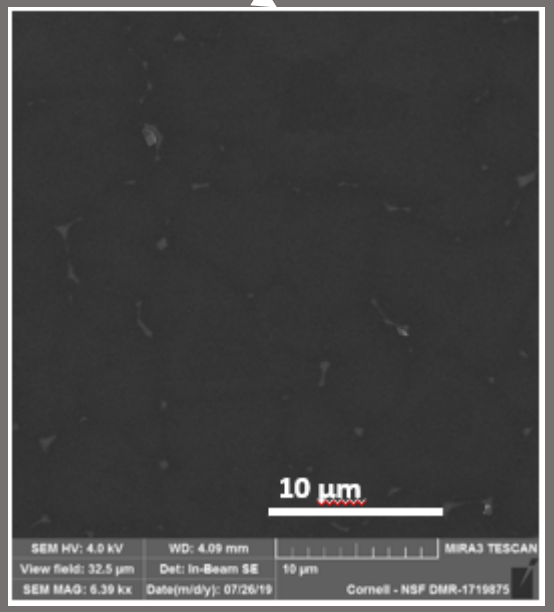

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Conclusions :

- Found an optimized reproducible recipe for monolayer uniform WS_2
- A rough version of WSe_2 has been made

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- Saien Xie
- Don Werder
- Darrell Schlom
- Julie Nucci