# Single-step synthesis and doping of TMDCs

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In this presentation we review a selection of recent work on Thermally Assisted Conversion (TAC). In the TAC process transition-metal dichalcogenides (TMDCs) are synthesized by alloying transition metals with chalcogens in a CVD reactor. While the materials grown by this method are polycrystalline, the process is very simple and directly adaptable to a wide variety of TMDCs.
By controlling the pressure of Chalcogen vapour, TAC can be applied to grow a large number of different TMDCs. We will present a survey of materials that can be synthesized using this simple method. Materials are characterized through Electron microscopy, XPS, and Raman Spectroscopy. [1,2]
By using a mixture of transition metals in the TAC process, dopants can be very simply introduced to TMDCs. A study of Rhenium as an *n*-type dopant for $MoS_2$ will be presented and contrasted with unintentional *p*-type doping by sulphur vacancies. Device measurements will be supported by a complimentary DFT study. [3]
By exploiting the simple TAC process, a number of novel approaches to device synthesis can be explored. As an example, we will show a single-step process for the growth of 1T' $MoTe_2$ electrodes for use in the Hydrogen Evolution Reaction (HER). [4]

## References

[1] Solid-State Electronics **125** (2016) 39
[2] Adv. Mater. Int., **5** (2018) , 5, 701161
[3] Appl. Phys. Lett., **111** (2017), 203101
[4] *ACS Appl. Energy Mater.*, **2**, (2019), 521

## Figures

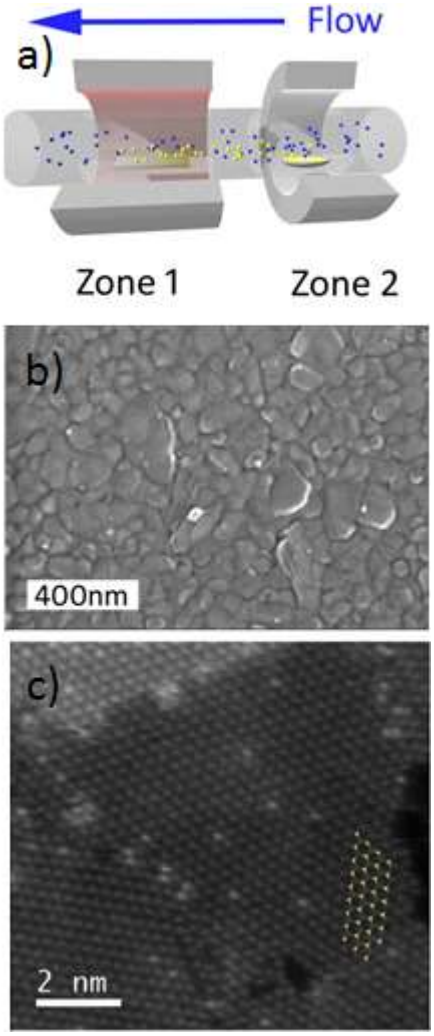


**Figure 1:** a) Schematic of TAC process. b) SEM image showing polycrystalline $MoS_2$ from TAC. C) AC-TEM image showing a monolayer $MoS_2$ lattice with Re dopant atoms.