# Field Effected Aerosol Assisted Chemical Vapour Deposition (FE-AACVD) of Thin Film Materials


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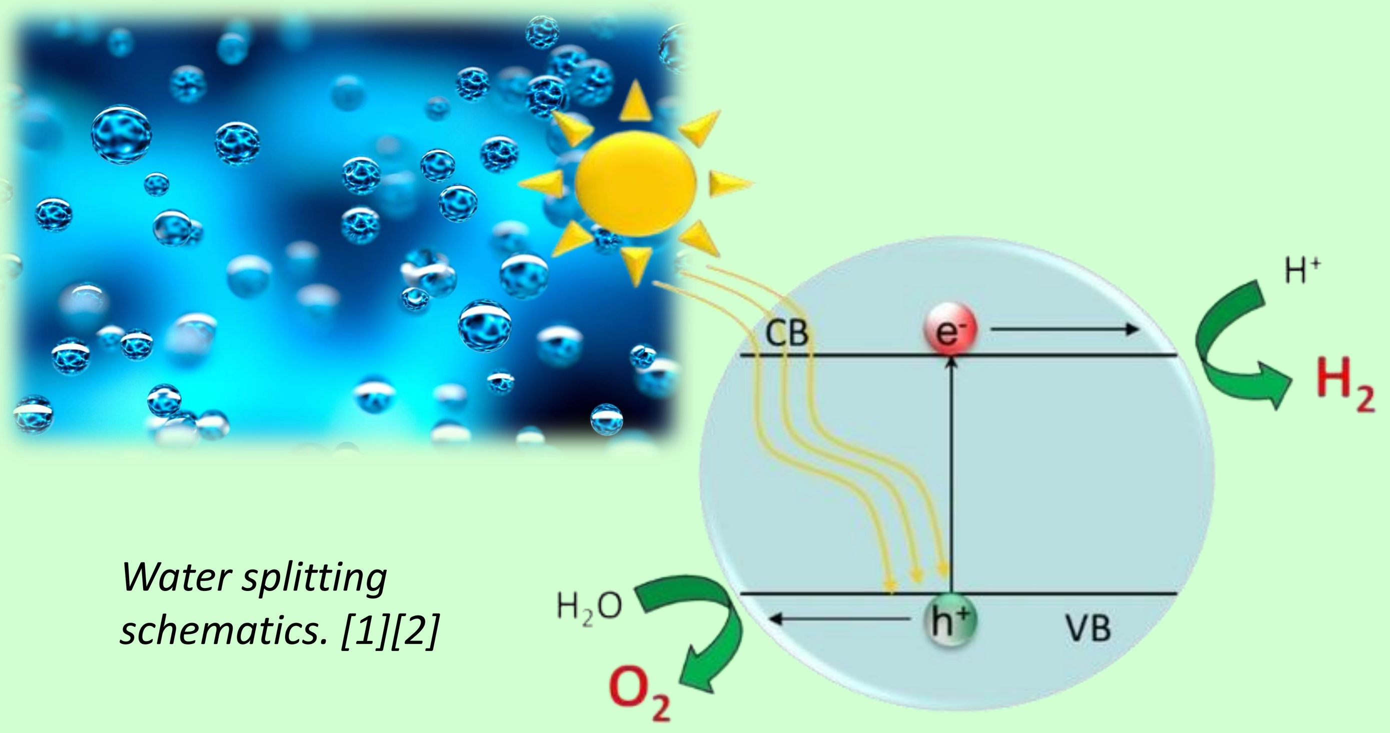



*Water splitting schematics. [1][2]*

## 1) Thin Films for Water Splitting

Photocatalytic water splitting aims to sustainably produce hydrogen, a fossil fuel alternative, from water and sunlight. Thin film semiconductors facilitate this via redox catalysis. Surface morphology and crystallinity of thin film materials can be tuned to increase their efficacy, stability and absorption range.

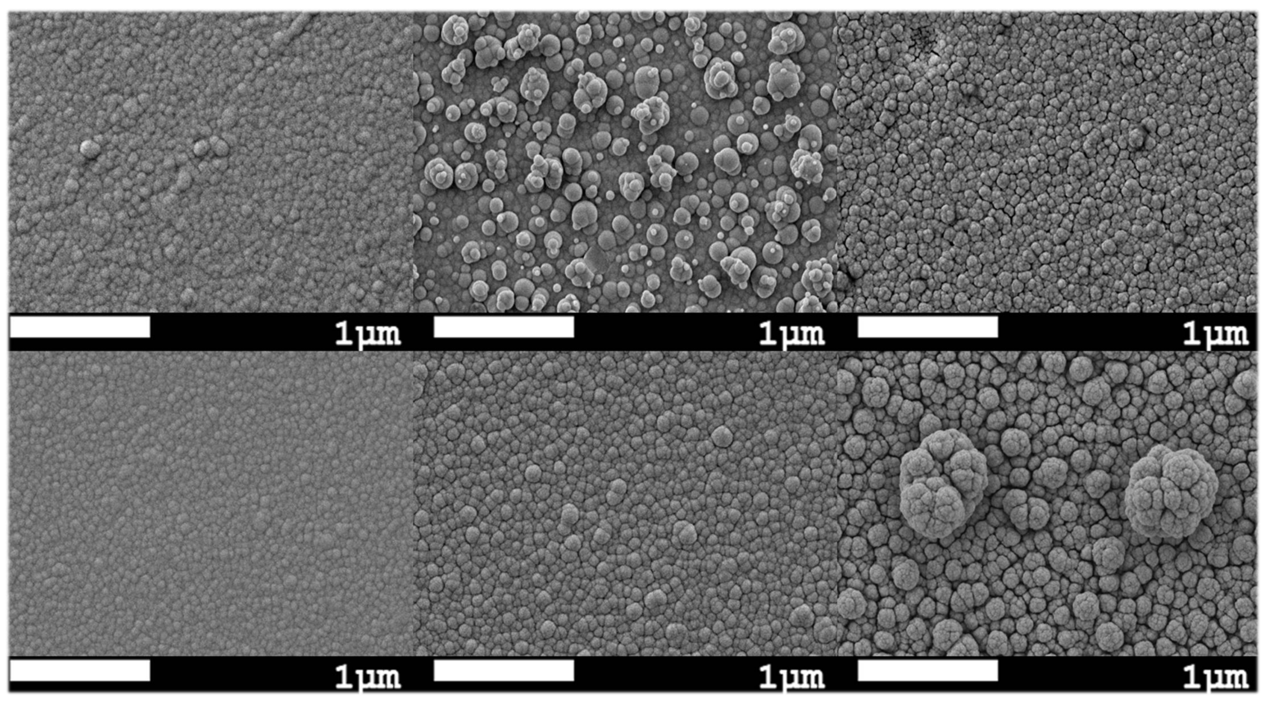
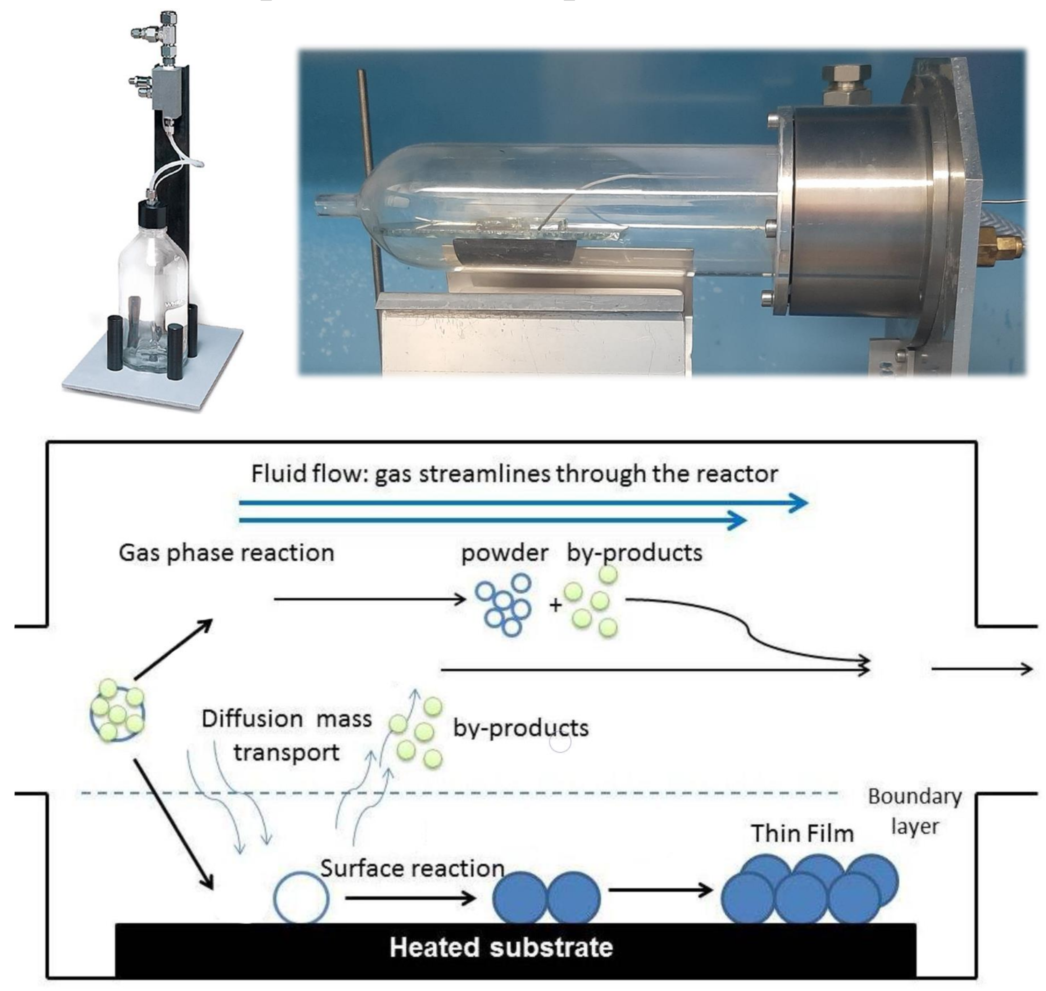



*Figure 1: Scanning electron microscope images of tantalum oxide thin films, showing their differing degrees of crystallinity.*

## 2) Aerosol Assisted Chemical Vapour Deposition

- ❖ Precursor solutions are aerosolised and transported to the reaction chamber
- ❖ Precursor aerosols deposit on the hot substrate and react
- ❖ Decomposition and evaporation of side groups generates a thin crystalline film of inorganic materials




*Figures 2, 3 and 4: A TSI 3076 aerosol generator, and schematics of an AACVD reaction chamber. [3][4]*

## 3) Chemical Precursors

- ❖ Need the correct elements to make the target thin film. No need for volatility but solubility is important
- ❖ Single source precursors are used to guarantee homogeneous films

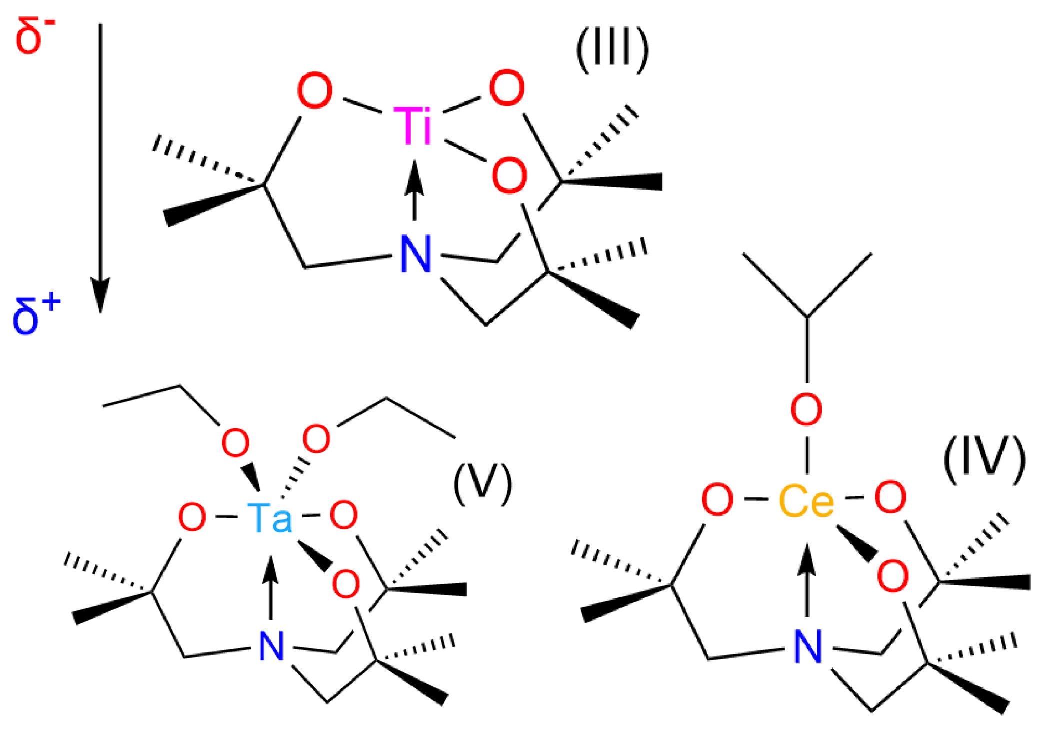
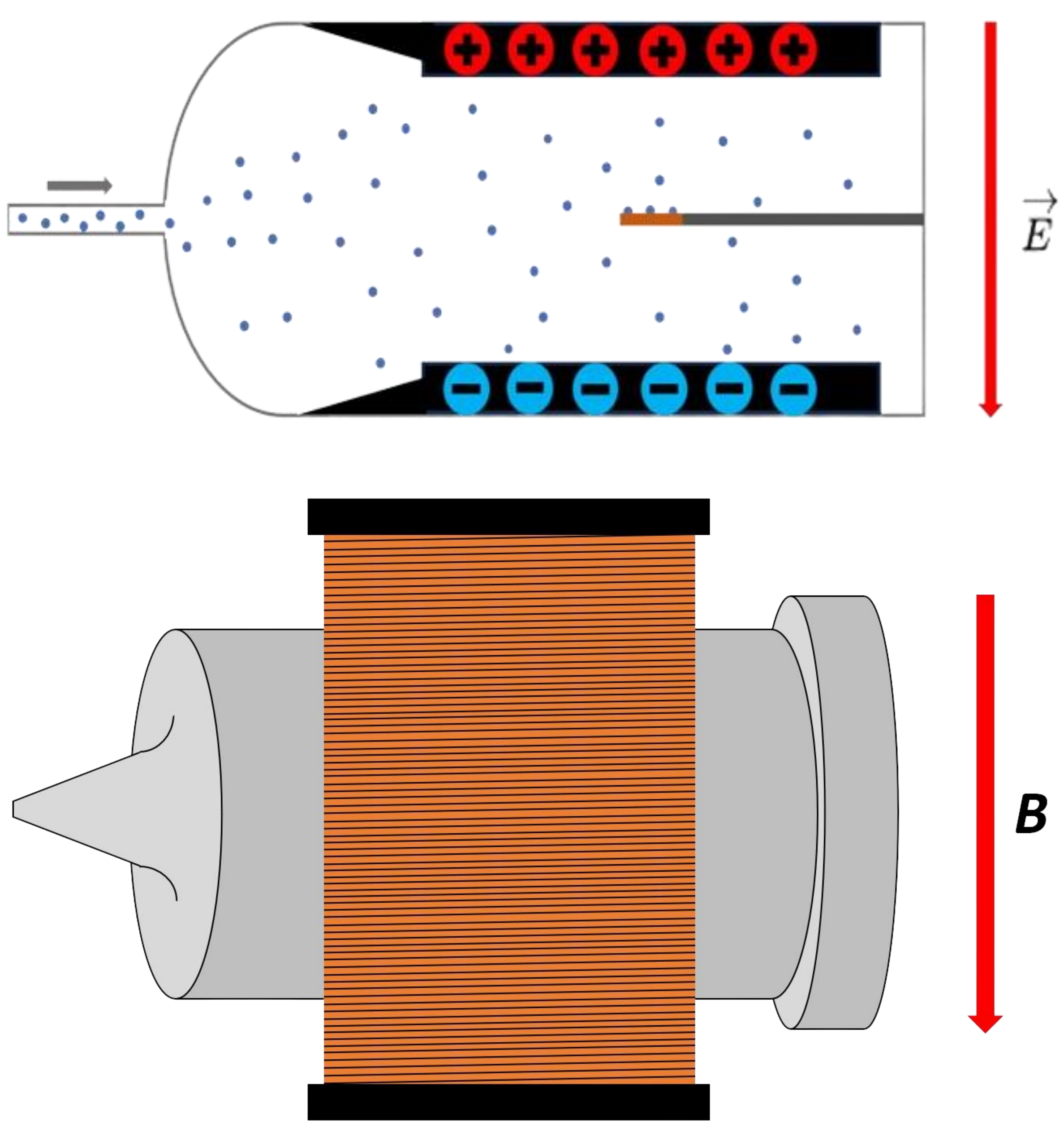



*Figure 5: Examples of single source AACVD precursors possessing synergy with applied fields.*

## 4) Directing Effects of Electric and Magnetic Fields

- ❖ Aerosols are affected by fields during transport and thin film synthesis
- ❖ Electric fields can direct charges and align dipoles on deposition
- ❖ Magnetic fields can direct paramagnetic species on deposition
- ❖ Crystallinity can be increased, and magnetic domains can be ordered




*Figures 6 and 7: Example AACVD schematics configured to use electric field direction and magnetic field direction.*

## 5) Challenges and Future Work

The work is among the first studies of electric field AACVD, and there is no literature precedent for magnetic field AACVD. The introduction of further variables to an already complex process means care must be taken to ensure both repeatability and reliability.

Two or more thin film layers are often needed for effective water splitting and research will be undertaken into stacking these. A corona discharge source will also be investigated to further alter aerosol properties and increase deposition efficiency.


[1] J. Zhang, C. Mück-Lichtenfeld and A. Studer, *Nature*, 2023, **619**, 506–513 [2] R. Marschall, *Eur J Inorg Chem*, 2021, **2021**, 2435–2441 . [3] TSI Instruments Ltd.
[4] L. Romero, PhD thesis, Queen Mary University of London, 2013.