UNIVERSITY of York

PhD Project in Physics 2019

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Project Title: **Plasma-Enhanced Pulsed Laser Deposition of metal-oxynitride thin films for photoelectrochemical water splitting to enable a hydrogen economy**

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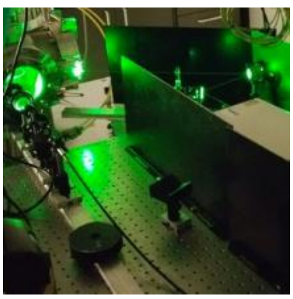
The hydrogen economy, the use of hydrogen as a clean fuel, is under development as a part of the future low-carbon economy. An important part of this is the efficient and cheap production of hydrogen. Photoelectrochemical water splitting is a promising technology that produces hydrogen from water using sunlight. Key in this technology are the photoelectrodes that use light energy to dissociate water molecules into hydrogen and oxygen.

Metal oxide thin films like TiO_2 and $SrTiO_3$ are the most prominent materials because of their efficient photocatalytic properties. However, the main drawback is that they require UV light which is only a small fraction of solar spectrum. A new class of materials, metal-oxynitrides, are a promising alternative since they are photo-active in the visible range. In particular TaON and TiON show great promise, if the composition and structure of the films can be carefully controlled and tuned, which is still a challenge.

This project aims to produce high-quality metal-oxynitride thin films for photocatalytic processes using a novel thin film deposition technique: Plasma-Enhanced Pulsed Laser Deposition (PE-PLD). PE-PLD combines traditional PLD with an external low-temperature plasma in oxygen and/or nitrogen. This allows greater control of the oxygen and nitrogen content of the deposited thin films, making it an ideal tool for creating metal-oxynitride films.

This project will focus on creating high-quality thin films but also on enhancing the understanding of the underpinning plasma physics and chemistry such that film properties can be created by design rather than empirical trial-and-error. For this you will combine state-of-the-art multiscale numerical modelling with direct measurements of plasma properties performed in the YPI Laboratories.



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