Ultra-thin oxide film photocathodes for accelerators and sensors

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Summary

Photocathodes are materials which emit electrons when illuminated by light of sufficiently short wavelength. This experimental PhD project will focus on advanced photocathodes made from ultra-thin metal oxide films. They will be grown by vacuum deposition, fully characterised and tested in two very different applications, namely accelerator science and UV detection.

PhD project outline

In collaboration with the ASTeC group at the Cockcroft Institute, we will investigate ultra-thin film metal oxides as photocathodes. These films will be applied: (1) in advanced linear accelerator applications, illuminated by ultra-short laser pulses; and (2) ultra-violet sensors for industrial and environmental applications, illuminated by low-intensity sources. We seek to improve the quantum yield of the photocathodes compared to conventional metal photocathodes. This will improve both accelerator efficiency and the responsivity of UV detectors. Apart from quantum yield, the number of electrons emitted per incident photon, there are numerous other requirements for the photocathodes in the two different applications (emittance, response speed, robustness and work function control).

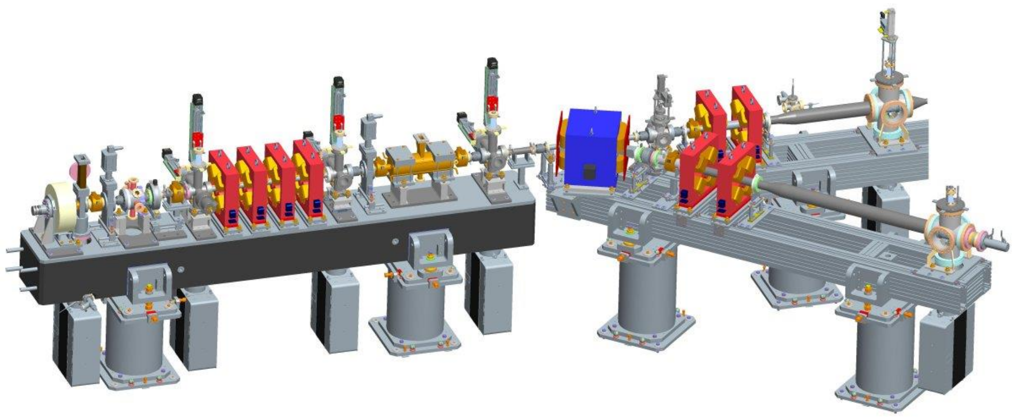

Figure: a schematic of the VELA accelerator at Daresbury Laboratories

You will perform growth and in situ analysis of the oxide films on metal substrates, correlating materials characteristics with functional properties. In years 1 and 2 you will be based in Warwick working on a new combined thin film growth / analysis system as well as completing training modules and transferable skills work. You will test the photocathodes in our patented UV detector systems, working with industry partners to characterise them for different applications. In year 3 you will be based at ASTeC, growing photocathode thin films directly on the pucks used in the VELA accelerator. They will be characterised in operando by six-dimensional phase space measurements at VELA. For year 4 (6 months funded), the student will return to Warwick for analysis and write-up. The project will also involve thin film analysis by medium energy ion scattering (MEIS).

This **Materials Physics Doctorate** project would suit students interested in experimentally-focused research on thin-film materials and surface science, alongside an opportunity to move into the field of accelerator science, which underpins a great deal of activity in particle physics, medical physics and analytical science.