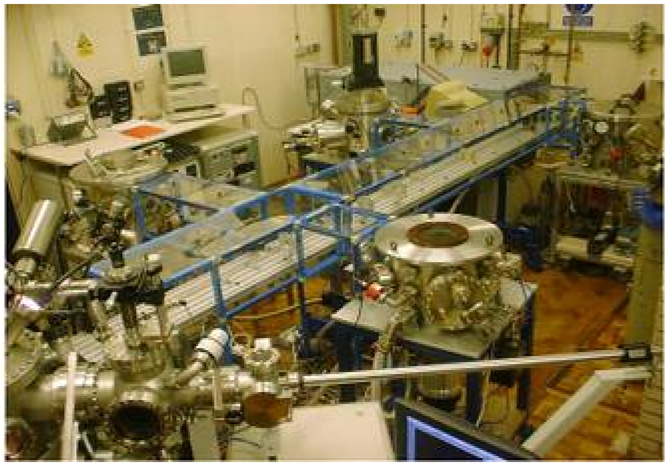
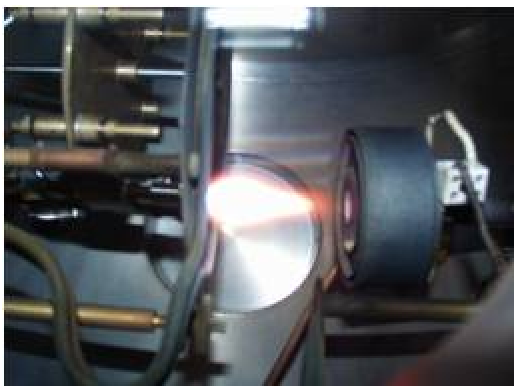
Emerging Device Technology > **Thin Film Development**



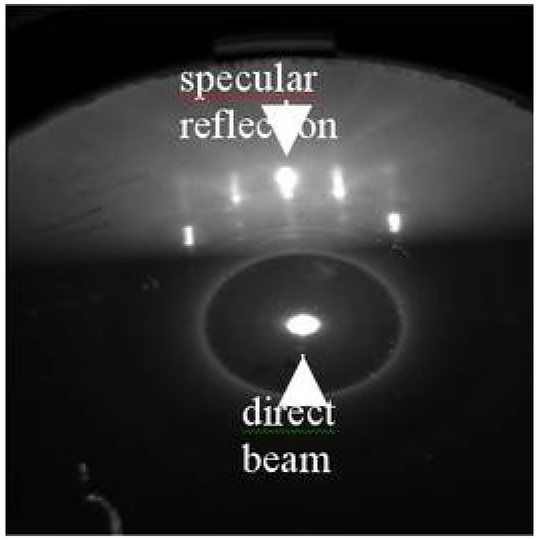
Thin films of ferroelectric and superconducting materials are grown in the interdisciplinary pulsed laser deposition laboratory. The photograph shows the laboratory. There are five deposition chambers. The chamber in the foreground is equipped with in-situ Reflection High Energy Electron Diffraction (RHEED) for monitoring film growth in real time. Continuing in an anti-clockwise direction the photograph shows the two chambers used by the School of Physics (for thin films of superconducting and magnetic oxides), the excimer laser, the chamber used by the Department of Metallurgy and Materials (for depositing high temperature superconducting coated conductors) and the chamber used by the EDT group for routine deposition of ferroelectric and superconducting thin films. The laboratory also houses an atomic force microscope.

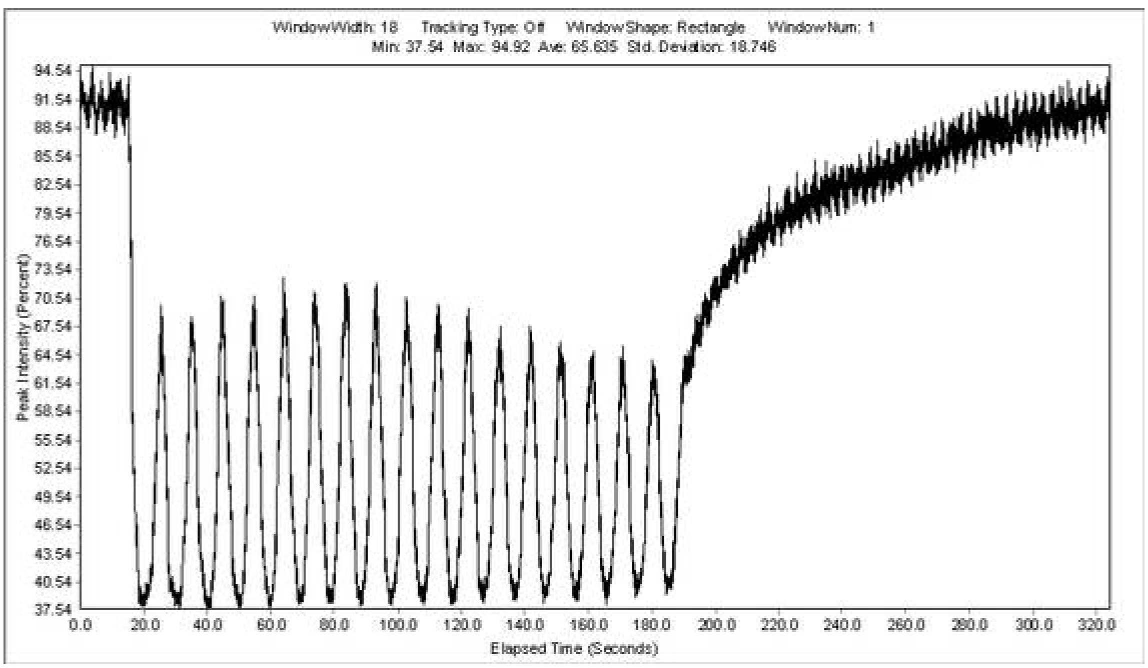
Pulsed Laser Deposition is particularly suited to the deposition of complex thin films like ferroelectrics. A pulsed, UV laser strikes a polycrystalline target of the ferroelectric material, producing a plasma plume. This plasma is condensed onto the heated, single crystal substrate. The whole process takes place in low pressure oxygen. The photograph shows the ablation plume produced from a YBCO target. High quality films are obtained by careful measurement of the pertinent properties as a function of deposition parameters such as oxygen pressure, substrate temperature, laser spot fluence and laser pulse repetition frequency.



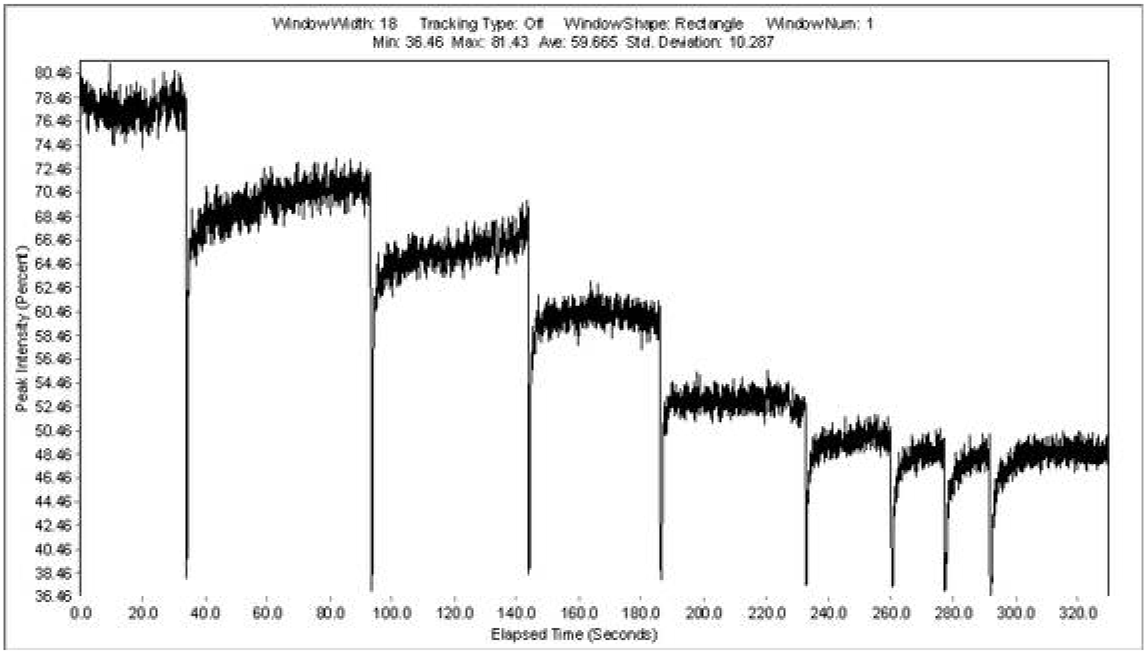
The images below show RHEED data taken during the growth of homoepitaxial strontium titanate thin films. The photograph shows the diffraction pattern from the substrate prior to the deposition. The middle image shows the oscillations in the intensity of the specular reflection during conventional deposition with a continuous stream of laser pulses.

The period of the oscillations corresponds to the time taken to deposit one monolayer. This intensity oscillation is a signature of two-dimensional, layer-by-layer growth. The lower image shows the temporal evolution of the intensity of the specular reflection when 80 laser pulses are fired in 100Hz bursts. During the interval between laser pulses, the intensity recovers as the deposited material rearranges to form a continuous and crystalline layer. This second method can be used to force a two-dimensional growth in heteroepitaxy too.





The oscillations in the intensity of the specular reflection during conventional deposition with a continuous stream of laser pulses.



The temporal evolution of the intensity of the specular reflection when 80 laser pulses are fired in 100Hz bursts.

In addition to electrical characterisation, we also make use of techniques such as X-ray diffraction (XRD), Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Raman spectroscopy and Atomic Force Microscopy (AFM) to understand the structure of our films.