“Progress in Tools and Applications at the Nanoscale.”

The ability of Nanotechnology to advance is, to a large extent, predicated by the availability of tools to enable access to data or devices creation. This paper will review the current progress in developing electron and ion beam tools which are advancing discovery, prototyping and production at, or below the nanoscale. As the discovery, prototyping and production environments all differ with respect to their objectives we shall discuss the different criteria, and trade-offs, the tool maker needs to take into consideration. In each area different types of metrology are required, in the discovery phase it is the need to provide as many forms of detection as possible to characterize the diverse and size dependant properties of materials; in the prototyping phase it is the ability to add, in addition, means to manipulate and modify structures; in production the target it is to be selective in the form of detection but to automate the measurement. One factor is common to all developments and the demand to decrease the time to a result. Sample throughput is becoming a new performance criterion in all fields. This factor in turn is driving the development of software which continuously improves and simplifies instrument control, and data handling. One of the most challenging areas in development is to transform these imaging instruments, originally designed to enhance the performance of the human eye, to fully automated systems capable of delivering the desired data without human intervention.
Examples will be given of the application of the new tools to solving problems in the fields of materials science, and proteomics, their versatility in prototyping, and progress in the development in tools capable of supporting high throughput metrology of nanoscale devices in a mass production environment.