Chapter 7
Correction of Artifacts and Optimization of Atomic Force Microscopy Imaging:
A Case of Thin Aluminum Films for Prosthetic Applications

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ABSTRACT

Acquisition of experimental data from atomic force microscopy (AFM) sometimes has artefacts that distort the information contained in the image. Such artefacts can be very delirious especially for sensitive applications such as in biomedical and microelectronics. This chapter illustrates the correction of the artefacts resulting from tapping mode imaging. It also shows the application of Taguchi optimization technique for reducing artefacts during AFM imaging. Using AFM images of Al films, Fourier filtering is illustrated as a useful technique for correcting the artefacts. Taguchi optimization is shown to determine the optimal scan rate, scan size, integral and proportional gains in minimizing the size and number of artefacts at the imaging stage. The correction technique is shown to improve the morphological information of the AFM images while the Taguchi method is effective for determining the best imaging conditions for AFM analysis.

DOI: 10.4018/978-1-5225-8235-9.ch007

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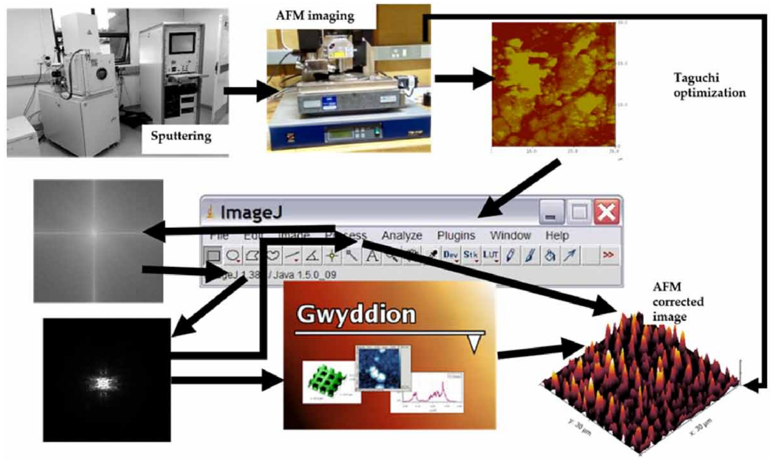
Box 1. Graphical abstract



INTRODUCTION

Atomic force microscopy (AFM) is one of the scanning probe microscope (SPM) techniques that provides lateral information and heterogeneity of surface topography at the nanoscale level, and its resolution can reach atomic measurements for perfectly flat surfaces (Anandhan 2003). The major advantage of AFM microscopy over the other microscopy techniques (such as optical, SEM, TEM, etc.) is that it does not require the tedious surface preparation, and therefore, it finds applications in a wide spectrum of nanomaterials including metals, polymers, composites and biological materials (Bandyopadhyay 2008). The versatility of AFM technology is further enhanced by its capability to image in different media, including vacuum, fluid and gas environment and as such its application cuts across all disciplines from life to physical sciences and engineering. It is possible to capture the atomic arrangement or molecules of various surfaces; for instance, at images of 5 nm scale, the crystallographic structure of materials in both life and physical sciences can be studied (Eaton and West 2010). The other advantage of AFM is that it can image nearly all types of materials' surfaces; be it very hard (metals, ceramics or polymers) or soft (animal cells, very thin lone standing films or genetic molecules).

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