1. Introduction

As for the definition of nanostructures, a widely accepted one is that “nanostructure” represents a system or object with at least one dimension in the order of 100 nm or less. Typical oxide nanostructures are of three types based on dimensional categories: 0D, 1D, and 2D. 0D nanostructures such as nanoparticles and 2D thin films have been extensively explored and utilized in many applications. A recent emerging of wire-like nanostructures is the 1D oxide nanostructures.

1D nanostructure is a material with two physical dimensions in the nanorange (1–100 nm), while the third one can be very large. Typically four types of 1D nanostructure configurations are reported in literature, including nanotubes [1], nanowires [2–5], nanorods [6–8], and nanobelts (nanoribbon) [9–13]. These nanostructures have potential applications in nanoelectronics, nanooptoelectronics, and nanoelectromechanical systems [3,4,14–23]. Figure 13.1 shows SEM images representing the four different typical morphologies made by ZnO. Among them, nanobelt (nanoribbon) is the latest one being recognized and investigated extensively since its discovery in 2001 [10]. By utilizing a dramatically increased surface-to-volume ratio and the novel physical properties brought by the nanoscale structure, nanoscale sensors and transducers with superior performance can be achieved [24].

In this chapter, a review will be provided focusing on the emerging growth techniques and morphological control of 1D oxide nanostructures. ZnO will be taken as a main example for demonstrating the novelty of oxide nanostructures.

2. Synthesis and Fabrication of 1D Nanostructures

During the past decade, 1D metal oxide nanostructures have been extensively investigated. Most of the studies have been focused on the synthesis and fabrication of the nanostructures. Two categories of synthesis and fabrication techniques are generally used. One is the “bottom-up” techniques using vapor phase deposition,
chemical synthesis, self-assembly, and location manipulations. The other is the “top-down” approach utilizing the lithography and precision-engineered tools like cutting, etching, and grinding to fabricate nanoscale objects out of bulk materials. In the “bottom-up” category, several approaches have been well established, which include an extensively explored vapor phase deposition method, including chemical vapor deposition (CVD) and physical vapor deposition (PVD), and liquid phase deposition (solution synthesis approach).

### 2.1. Vapor Phase Deposition Method

Vapor phase deposition method is the most versatile method for synthesis and fabrication of 1D nanostructures in the past few years. CVD and PVD are two typical vapor phase deposition methods. Both methods can be subclassified based on the source of energy used, as summarized in Table 13.1 [25].