CHAPTER 1
INTRODUCTION

1.1 Overview

$1\ \mu m = 10^{-6}\ m$ $\qquad$ $1\ nm = 10^{-9}\ m$

nanometer range: 1~100 nm (diameter or thickness)

0-D nanomaterials: all dimensions at the nanoscale
nanoparticles (spheres, cubes, etc...)

1-D nanomaterials: two dimensions at the nanoscale
nanorods, nanotubes, nanowires (aspect ratio)

2-D nanomaterials: one dimension at the nanoscale (thickness $\leq$ 100 nm)
nano-sized thin films, nano-sized membranes

3-D nanomaterials: nanocrystalline in bulk form
nanocrystalline materials, nanocomposites, nanoporous materials

Nanomaterials can be: amorphous or crystalline (or semi-crystalline)
single crystalline or polycrystalline
chemically pure or impure (or various chemical compositions)
metallic, ceramic, or polymeric
in solution, stand alone, or embedded in another medium

	Nano-objects	Surface materials	Bulk materials
0-D (3 dimensions on nano scale)	nanoparticles	nanocrystalline films	nanocrystalline materials nanoparticle composites
1-D (2 dimensions on nano scale)	nanorods nanotubes nanowires	nano-interconnects	nanotube-reinforced composites
2-D (1 dimension on nano scale)	thin films membranes foils	nano-surface layers	multilayer structures