

Classification and division of nanomaterial structures

[Science](#), [Chemistry](#)



Nanostructures have attracted steadily growing interest due to their fascinating properties, as well property microstructure correlation. They can be divided into three kinds, namely 0D, 1D, and 2D nanostructures based on their shapes

Nanostructures can be divided into:

- (i) zero-dimensional (0D) when they are uniform,
- (ii) one-dimensional (1D) when they are elongated, and
- (iii) two-dimensional (2D) when they are planar based on their shapes.
- (iv) three-dimensional (3D)

The recent emphasis in the nanomaterial research is put on 1D nanostructures at the expense of 0D and 2D ones, perhaps due to the intriguing probability of using them in a majority of short-term upcoming applications. There is a large number of new chances that could be realized by down-sizing currently existing structures into the nanometer scale (<100 nm), or by making new types of nanostructures.

0D nanostructures

In the past decades, significant progress has been made in the field of 0D nanomaterials and nanostructures and a rich variety of methods have been established for fabricating 0D nanostructures with well-controlled dimensions. Here some example for 0D nanostructures of 0D ZnS nanostructures, such as nanocrystals (quantum dots), core/shell nanocrystals (NCs), and hollow nanocrystals. Recently, 0D NSMs such as uniform particles arrays (quantum dots), heterogeneous particles arrays, core-shell quantum

dots, onions, hollow spheres and Nano lenses have been synthesized by various research groups.

1D nanostructures

1D nanostructures have stimulated an increasing interest due to their importance in basic scientific research and potential technological applications. It is usually believed that 1D nanostructures are ideal systems for exploring a large number of novel phenomena at the nanoscale and investigating the size and dimensionality dependence of functional properties. They are also expected to play vital roles as both interconnects and the key units in fabricating electronic, optoelectronic, electrochemical, and electromechanical devices with nanoscale dimensions.

2D nanostructures

2D nanostructures have two dimensions outside of the nanometric size range. In recent years, a synthesis 2D NSMs have become a principal area in materials research, owing to their many low dimensional characteristics different from the bulk properties. In the quest of 2D NSMs, considerable research attention has been focused over the past few years on the development of 2D NSMs. 2D NSMs with certain geometries display unique shape-dependent characteristics and subsequent utilization as building blocks for the key components of nanodevices. In addition, a 2D NSMs are particularly exciting not only for basic understanding of the mechanism of nanostructure growth, but also for investigation and developing novel applications in sensors, photocatalysts, nanocontainers, nanoreactors, and templates for 2D structures of other materials.

3D nanostructures

Owing to the large specific surface area and other superior properties over their bulk counterparts arising from quantum size effect, 3D NSMs have attracted considerable research interest and many 3D NSMs have been synthesized in the past 10 years. It is well known that the behaviors of NSMs strongly depend on the shapes, sizes, dimensionality and morphologies, which are thus the key factors to their ultimate performance and applications. Therefore, it is of great interest to synthesize 3D NSMs with a controlled structure and morphology. In addition, 3D nanostructures are an important material due to its wide range of applications in the area of catalysis, magnetic material and electrode material for batteries. Furthermore, the 3D NSMs have recently attracted intensive research interests because the nanostructures have higher surface area and supply enough absorption sites for all involved molecules in a small space. On the other hand, such materials with absorbency in three dimensions could lead to a better transport of the molecules.