

## Chapter 19

# Silica Nanospheres

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### 19.1 INTRODUCTION

The biggest challenge for modern-day researchers working in the field of medicine is drug delivery, specifically to targeted cells. Nanoparticles have emerged as the most suitable perspective on nanoparticulate drug carriers, which can access different tissues, cross physiological barriers, and also be provided in a targetable form focused at increasing cell specificity of the carriers. This controlled drug delivery has made rapid and substantial progress in the past few decades, various drug delivery platforms like inorganic matrix and polymeria have been designed, developed, and tested based on physiochemical properties of encapsulated drug and clinical requirements. Based on these facts silica has emerged as the most attractive option. Silica appears in two allotrope forms: (1)  $\alpha$ -quartz, which is a crystalline form arranged in  $\text{SiO}_4$  units; (2) amorphous form, which lacks long-range order arrangement of the atoms. This amorphous form is associated with low toxicity, in fact silica nanoparticles (SNPs) are an FDA-approved food additive. Mesoporous silica nanoparticles (MSNs) have high surface areas generally  $>800\text{ m}^2/\text{g}$ , ordered pore network (variable pore diameter 2–10 nm), high pore volume, and in addition the presence of silane containing functional group has made them the most sought after for target drug delivery. C.T. Kresge in 1992 discovered surfactant-templated synthesis of MSNs. Since then, majority of studies have focused on the synthesis, functionalization, and application of these structurally ordered materials for drug delivery. This transport system is well recognized for delivery of various drugs, which have high drug-loading capacity. Several researchers have reported that appropriate shape, size, and surface functionality of mesoporous materials make them efficient for endocytosis with live cells with high biocompatibility. A mesoporous material contains pores having diameter in the range of 2–50 nm. These new kind of materials (MSNs) are excellent candidates for intracellular delivery by controlled release. Achieving this goal would require