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Mesoporous silica based nanoparticles are of potential interest for the development of novel therapies in nanomedicine due to their high surface areas (above 1000 m²/g), large internal pore volumes and unique ordered porous structures. These arise from the use of self-assembling organic templating agents during the sol-gel preparation of the amorphous silica, enabling the design of pore sizes (between 2-50nm), pore structure, connectivity, as well as their particle size and surface chemistry, with unprecedented control.1] Their uses in pharmaceutics to improve drug bioavailability and formulation; to mitigate drug toxicity, to act as adjuvants in immunoregulation and in cellular targeting through controlled drug delivery strategies has been demonstrated.1-3] This presentation aims to review some of the groundbreaking work being conducted at the interface between materials science and nanomedicine using mesoporous nanostructures drawing particular attention towards the Structure and Function relations and how advanced characterization methods such as those based on Electron Crystallography and Electron Microscopy can help in the design of tailor made structures for applications in the Pharmaceutical Sciences.4] Examples will be shown of the use of mesoporous nanoparticles for the pharmacokinetic control and enhancement of bioavailability of pharmaceutical drugs as well as for the delivery of peptides in the context of regenerative medicine.5-6]

Figure 1. An electron Crystallography derived unit cell model of cubic mesocaged material (AMS-8) viewed along the [111] orientation (left). TEM image of a typical AMS-8 particle viewed along its [110] orientation (center) and its uptake within a primary human macrophage (right) as seen under the electron microscope.