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Synthesis of mesoporous silica nanoparticles by variation of microwave power for the ibuprofen drug delivery

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Mesoporous silica nanoparticles (MSN), which combine both unique properties of nanomaterials and mesostructured substances, have arouse special attention in biomedical research field due to its great advantages in many aspects such as well biocompatible, unique properties of tunable pore size and structure, large surface areas and pore volumes, controllable morphology and modifiable surfaces[1-2]. The traditional synthesis method of mesoporous materials is the hydrothermal route, which uses a certain amount of surfactants, as well as acid or alkali to compose a mixed aqueous preparation. Although finely ordered mesoporous materials are obtained, the process is time and energy consuming[3]. It is known that microwave (MW) heating promotes nucleation and can reduce the synthesis time and particle size significantly in comparison with the conventional convection heating method[3]. For the synthesis of periodic mesoporous organosilica, it was reported that the synthesis time was reduced from 72 h to 36 h when the self-assembly process was performed under MW irradiation. The resulting materials also exhibited a high surface area, large pore volume and large pore diameters[4].

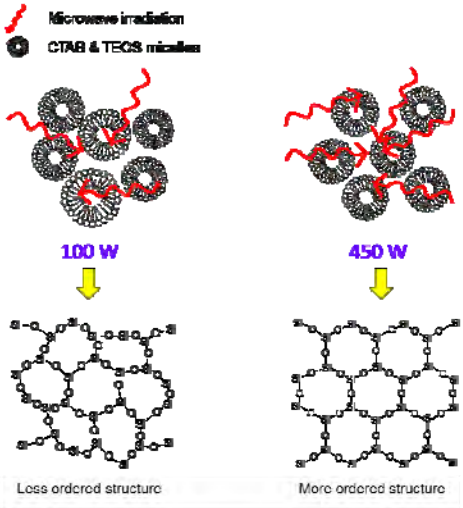

Figure 1 Formation of MSN structure under microwave irradiation

Within this context, the microwave was utilized to synthesize the MSN under 100 W, 300 W and 450 W heating powers. Ammonia was chosen as the catalyst and ethylene glycol as the co-solvent because of their polarity, which is higher than that of NaOH and methanol or ethanol which are commonly used to synthesize mesoporous silica. All MSNs was tested for adsorption and release of an anti-inflammatory and anti-cancer drug, ibuprofen. The characterization revealed that the MSN prepared under 450 W (MSN_{450}) produced the most crystallized and prominent mesoporous structure compared to lower power applied (**Figure 1**). MSN_{450} exhibited the highest ibuprofen adsorption, followed by MSN_{300} and MSN_{100}, confirming that more crystallized MSN demonstrated higher adsorptivity toward ibuprofen. For the release study, MSN_{450} showed the slowest release rate of ibuprofen, followed by MSN_{300} and MSN_{100}. All MSNs was found to exhibit good activity for the ibuprofen adsorption and release.

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