Aqueous Stability of Zeolitic Imidazolate Framework-8 Nanoparticles for Biomedical Applications

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Zeolitic imidazolate framework-8 (ZIF-8) is a class of metal-organic frameworks (MOFs) composed of Zn ions and 2-methylimidazolate linkers and has been used in various fields such as catalysis, separation, gas storage. Recently, the use of ZIF-8 nanoparticles as drug carriers has attracted growing attention owing to its mesoporous nature, size tunability, capability to encapsulate small drugs as well as biomolecules such as nucleic acids and proteins, and pH-sensitive dissociation under slightly acidic conditions that can be found in endosomes/lysosomes in cells.

However, since ZIF-8 contains relative labile Zn-N bindings, evaluation of its stability in aqueous solutions is essential for further exploring the potential use of ZIF-8 nanoparticles in biomedical applications. In this study, we prepared ZIF-8 nanoparticles with different size ranges and examined the effects of water on the size and morphology of ZIF-8 nanoparticles. The particles were incubated in water for different durations and observed by field emission scanning electron microscopy. We found that the ZIF-8 nanoparticles gradually transformed from a rhombic dodecahedral structure to a flower-like structure after incubating in water for three days. Furthermore, the small ZIF-8 nanoparticles with diameter of 80 nm showed faster phase transformation compared to those with a larger diameter of 900 nm. The results indicate the involvement of the coordinatively-unsaturated Zn center on the outermost particle surface in the hydrolysis of the ZIF nanoparticles.