Hydrogen Bond-Triggered Synthesis of Mesoporous SiO_2 Nanoparticles for Environmental Remediation Nanomaterials

Won San Choi,[1] Md. Shahinul Islam,[2] Ha-Jin Lee[2]

[1]Department of Chemical and Biological Engineering, Hanbat National University, 125 Dongseodaero, Yuseong-gu, Daejeon 305-719, Republic of Korea
[2]Western Seoul Center, Korea Basic Science Institute, 150 Bugahyun-ro, Seoudaemun-gu, Seoul, 120-140, Republic of Korea
choiws@hanbat.ac.kr

Abstract A novel strategy for the synthesis of mesoporous silica nanoparticles (MSNPs) using a surfactant-free method under ambient conditions has been demostrated. By the simple addition of an amine-based polymer (polyethylenimine; PEI) with a high molecular weight to a silica nanoparticle (SNP) solution, two types of MSNPs, including rambutan-like MSNPs (R-MSNPs) and hollow MSNPs (H-MSNPs), were produced. The structural changes of the MSNPs were systematically studied using various reaction conditions (reaction time, molar ratio and molecular weight of PEI, etc.) and were observed using electron microscopic techniques. The formation mechanisms of both MSNPs were carefully investigated using XPS and Raman and IR spectroscopies. Because the synthesized MSNPs are highly porous materials that contain internal organic/inorganic networks, we investigated the removal/adsorption properties of these MSNPs with respect to pollutants toward possible future use in environmental remediation applications. The H-MSNPs exhibited better environmental remediation capabilities relative to the R-MSNPs because PEI is present between the cobweb-like internal structures of the H-MSNPs, thereby providing a significant number of reaction sites for the adsorption of pollutants. The approach presented here can also be used as a direct method for the preparation of intra-connected networks within the substructures.

References

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