

Fabricating Nanoporous Nanofactories Entrapping Fe₃O₄ Magnetic Nanoparticles and Oxidases for a Colorimetric Biosensor

김문일, 심종민¹, 이태화, 이진우¹, 박현규*

KAIST; ¹POSTECH
(hgpark@kaist.ac.kr*)

Inorganic Fe₃O₄ magnetic nanoparticles (MNPs) have gathered great attention due to their extraordinary peroxidase mimicking activity. To achieve a facile system of MNPs as next-generation alternative to peroxidase, herein, we describe an one-pot multi-catalyst system, so called “nanofactory”, entrapping MNPs and oxidases in large pore sized mesoporous silica with high weight loadings of MNPs and enzymes (40 wt% MNP and 20 wt% enzymes). First, we incorporated MNPs into the mesocellular pores of the silica (Magnetic Mesoporous Silica: MMS) by impregnation of Fe(NO₃)₃ followed by heat treatment, and then enzymes were immobilized in the remaining volume of the MMS. To utilize the nanofactory to detect clinically important substrates, glucose oxidase and cholesterol oxidase were incorporated. Using the multi-catalyst system, as low as 3 μM glucose and 5 μM cholesterol could be detected colorimetrically. The nanofactory developed in the present work therefore provided both highly loaded MNPs and any enzymes in immobilized form, thereby making further applications as versatile sensors for detecting pathogenic DNA, protein, and cell highly promising.