Colorimetric alcohol sensor using magnetic nanoparticles as peroxidase mimetics and alcohol oxidase

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Inorganic Fe_3O_4 magnetic nanoparticles (MNPs) have gathered great attention due to their extraordinary peroxidase mimicking activity. However, practical applications of MNPs as peroxidase mimics have several bottlenecks, such as uneasy separation and reusability, lower activity and stability, and inaccessibility with another catalyst like enzymes. Herein, we report one-pot multi-catalyst system, so called "nanofactory", entrapping MNPs and oxidase in mesoporous silica with high loading (40 wt% MNPs and 20 wt% enzyme). This nanofactory was found to have similar affinity with substrates compared to bare MNPs proving excellent dispersion of MNPs in the mesoporous matrix of silica and facile substrate transfer. This nanofactory was used to detect clinically important substrates such as alcohol by oxidizing colorimetric peroxidase substrates. During the reaction, H_2O_2 was produced by incorporating alcohol oxidase in the remaining volume of the mesopores of nanofactory. Thus the nanofactory developed in the present work demonstrated superior activity, stability, and reusability, and can be used for detection of DNA, protein, and cells in future.