On-demand activatable Nanozymatic composite films for colorimetric sensing

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Iron oxide nanoparticles have attracted a great deal of attention as an artificial non-proteinaceous enzyme that mimics the catalytic characteristics of peroxidase in applications such as immunoassays and the detection of biochemicals including glutathione, ascorbic acid in fruit, and glucose and cholesterol in blood and urine.[1,2] These nanoparticles can oxidise the substrate 3,3′,5,5′-tetramethyl benzidine (TMB) in the presence of hydrogen peroxide. Despite iron oxide nanoparticles being commonly studied as nanozymes, nanoparticle aggregation particularly when used in isolation typically takes place in an aqueous environment decreasing their total surface area, and thus significantly compromising control over their catalytic activities.[3] To this end, iron oxide nanoparticles have been immobilised on solid substrates including nanoparticles and polymer matrices.[2,4] However, despite the advantage of overcoming nanoparticle aggregation to some extent, these substrate-based approaches do not provide any tuneability in the catalytic response. The present work reports the fabrication of nanocomposite films with tuneable and sustained catalytic response on demand as a first example of its kind. We employed *in situ* miniemulsion polymerisation to prepare colloidally stable iron oxide-silica nanoparticle (FeSiNP)-loaded poly(styrene-*stat*-*n*-butyl acrylate) nanocomposites with an innate ability to undergo film formation at ambient temperature. The resultant films demonstrated tuneable nanozyme activity, which was responsive to different extents of stretching of the films. Furthermore, the films provided prolonged activity, which was further increased by stretching. This is the first report that confirms the control over nanozyme activity by fabricating tuneable films, which can be used in the development of smart sensors or coatings for various applications.

References:

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