

Synthesis of Double Dye-Doped Silica Nanoparticles and Its Application in Paper-Based Chromatography

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Abstract : Lateral flow test is a prevalent technology in various sectors such as food, pharmacology and biomedical sciences. Colloidal gold (CG) is widely used as the signalling molecule because of the ease of synthesis, bimolecular conjugation and its red colour due to intrinsic SPRE. However, the production of colloidal gold is costly and requires vigorous conditions. The stability of colloidal gold are easily affected by environmental factors such as pH, high salt content etc. Silica nanoparticles are well known for its ease of production and stability over a wide range of solvents. Using reverse micro-emulsion (w/o), silica nanoparticles with different sizes can be produced precisely by controlling the amount of water. By incorporating different water-soluble dyes, a rainbow colour of the silica nanoparticles could be produced. Conjugation with biomolecules such as antibodies can be achieved after surface modification of the silica nanoparticles with organosilane. The optimum amount of the antibodies to be labelled was determined by Bradford Assay. In this work, we have demonstrated the ability of the dye-doped silica nanoparticles as a signalling molecule in lateral flow test, which showed a semi-quantitative measurement of the analyte. The image was further analysed for the LOD=10 ng of the analyte. The working range and the linear range of the test were from 0 to 2.15µg/mL and from 0 to 1.07 µg/mL ($R^2=0.988$) respectively. The performance of the tests was comparable to those using colloidal gold with the advantages of lower cost, enhanced stability and having a wide spectrum of colours. The positives lines can be imaged by naked eye or by using a mobile phone camera for a better quantification. Further research has been carried out in multicolour detection of different biomarkers simultaneously. The preliminary results were promising as there was little cross-reactivity being observed for an optimized system. This approach provides a platform for multicolour detection for a set of biomarkers that enhances the accuracy of diseases diagnostics.

Keywords : colorimetric detection, immunosensor, paper-based biosensor, silica

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