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Phase Control of Nanostructured Iron Oxide for Application to Biosensor

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SEM Studies

Fig. S1 (a) and S1 (b) show micrographs of the ChOx immobilized α-Fe_2O_3 films (obtained from Fe_3O_4 NPs and Fe_3O_4 NPs (autoclaved), respectively). The change in morphology from dense uniform distribution of NPs in the nanoscale to the globular structure of ChOx in the micron scale is attributed to physical adsorption of ChOx molecules onto α-Fe_2O_3 films[1]. Fig. S1 (c) and S1 (d) show the micrographs of ChOx immobilized Fe_3O_4@ C and Fe_3O_4@ SiO_2 films, respectively. The globular structure obtained in the micron scale (characteristic of proteins and enzymes) reveal the enzyme (cholesterol oxidase) immobilization onto the carbon and silica capped Fe_3O_4 films[2].

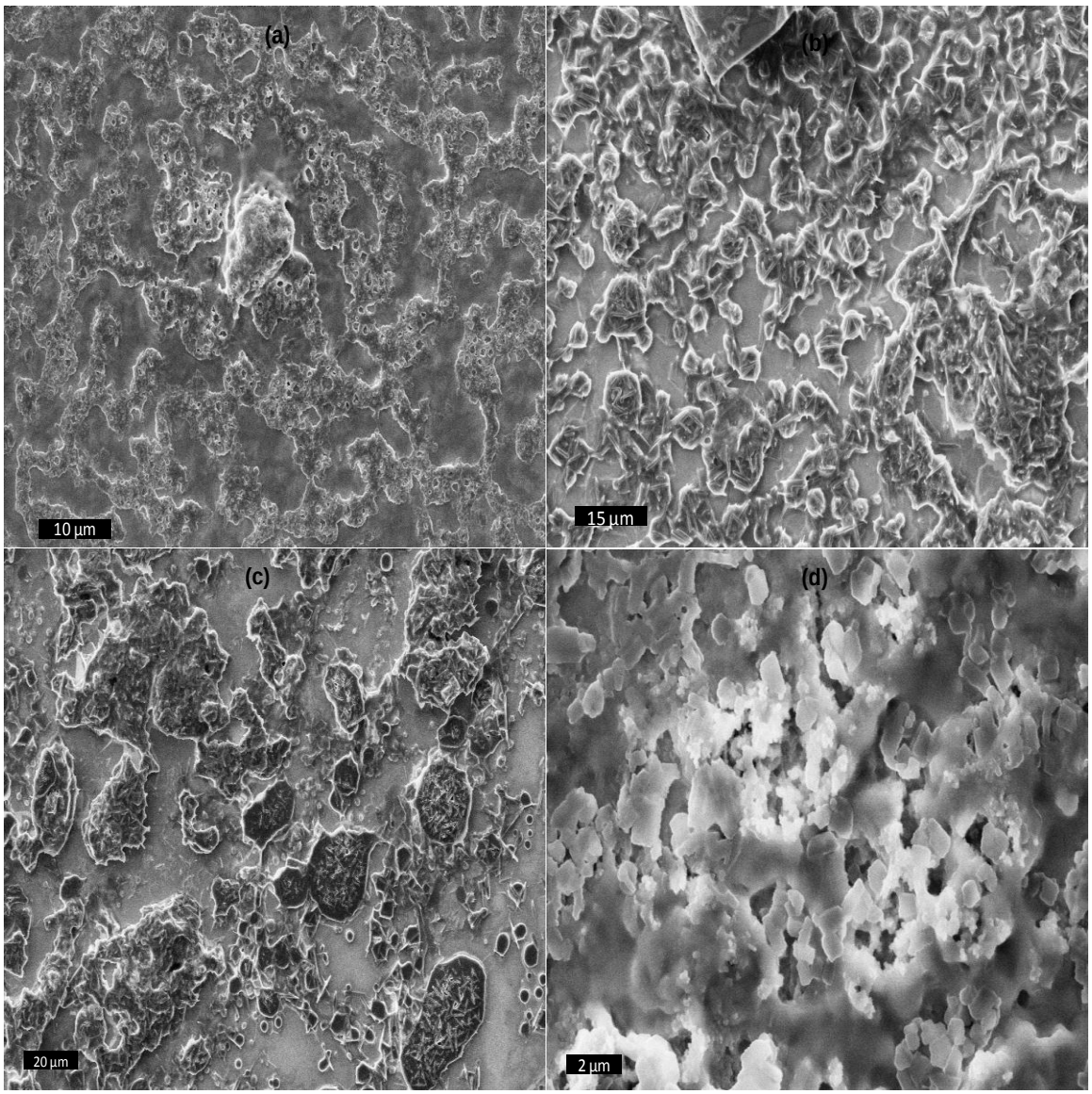

Fig. S1 SEM micrographs after ChOx immobilization onto: (a) α-Fe_2O_3 NPs film obtained from Fe_3O_4 NPs; (b) α-Fe_2O_3 NPs film obtained from Fe_3O_4 NPs (autoclaved); (c) film of Fe_3O_4@ C NPs; (d) film of Fe_3O_4@ SiO_2 NPs.

Shelf life Studies

The shelf-life of the ChOx/ Fe_3O_4@ C film/ITO and ChOx/ α-Fe_2O_3 film/ITO bioelectrodes has been investigated using cyclic voltammetry for 100 $mgdL^{-1}$ cholesterol concentration. The activity of the bioelectrodes has been investigated at regular interval of 7 days. The ChOx/ Fe_3O_4@ C film/ITO bioelectrode exhibits only 6% reduction in peak current after 10 weeks [Fig. S2 (a)] while ChOx/ α-Fe_2O_3 film/ITO bioelectrode exhibits 11.5% decrease in the peak current [Fig. S2 (b)] after 10 weeks when stored at 4°C. Thus, the shelf life of the ChOx/ Fe_3O_4@ C film/ITO bioelectrode has been found to be 10 weeks over the shelf life of 8 weeks for the ChOx/ α-Fe_2O_3 film/ITO bioelectrode within 95 % accuracy.

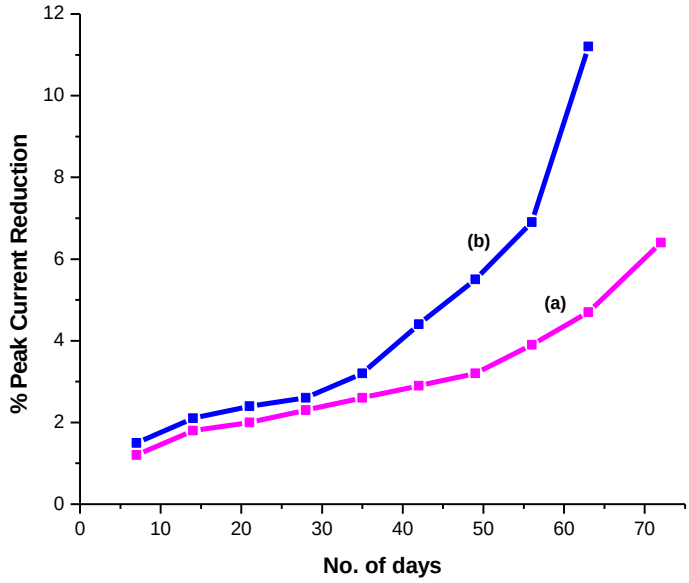

Fig. S2 Shelf life curves showing % reduction in peak current with time (a) ChOx/Fe_3O_4@ C film/ITO bioelectrode, and; (b) ChOx/α-Fe_2O_3 film/ITO bioelectrode.

Reproducibility Studies

The reproducibility of the ChOx/ Fe_3O_4@ C film/ITO and ChOx/ α-Fe_2O_3 film/ITO bioelectrodes has been studied with cholesterol concentration of 25 mgdL^{-1} and it has been found that the ChOx/ Fe_3O_4@ C film/ITO bioelectrode can be used upto 25 times without significant decrease (40 µA) of the signal [Fig. S3 (a)]. Under similar conditions, the ChOx/ α-Fe2O3 film/ITO bioelectrode can be used upto 20 times with insignificant loss (66 µA) of the signal [Fig. S3 (b)].

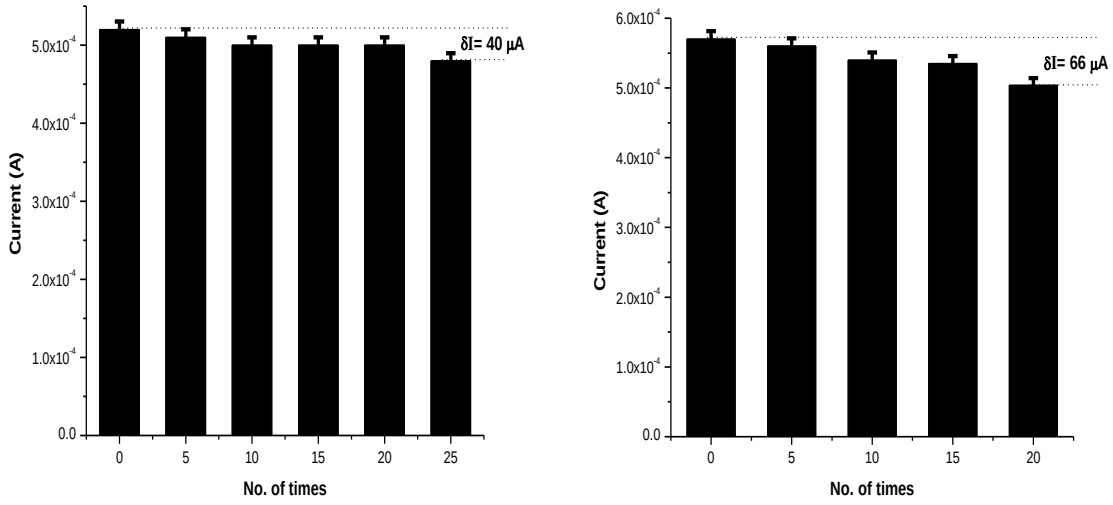

Fig. S3 Reproducibility curve showing reduction in peak current with no. of usage times (a) ChOx/Fe_3O_4@ C film/ITO bioelectrode, and; (b) ChOx/α-Fe_2O_3 film/ITO bioelectrode.

Response time Studies

The response time of the ChOx/ Fe_3O_4@ C film/ITO and ChOx/ α-Fe_2O_3 film/ITO bioelectrodes has been investigated using cyclic voltammetry for the cholesterol concentration of 100 mgdL^{-1}. The oxidation peak current shows linear rise in current initially and then saturate afterwards. The time after which the current shows no further increase in current has been taken as the response time and the response time of both the bioelectrodes have been found as 60 s.

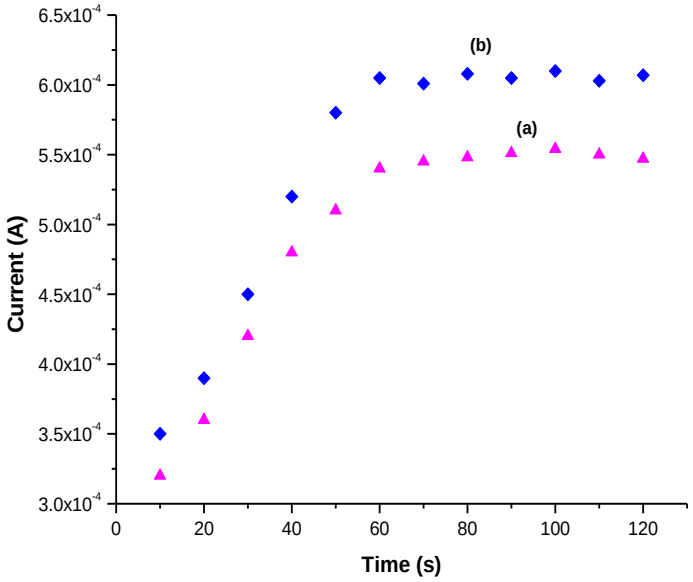

Fig. S4 Response time curve showing variation of peak current with time (a) ChOx/Fe_3O_4@ C film/ITO bioelectrode, and; (b) ChOx/α-Fe_2O_3 film/ITO bioelectrode.

References

1) Z. Matharu, P. Pandey, *Electroanalysis*, 2009, ***21***, 1587.

2) Z. Matharu, G. Sumana, *Langmuir* 2007, ***23***, 13188.