A rational approach to tailor Au-IrO_2 nanoflowers as colorimetric labels for lateral flow assays

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Lateral flow assay (LFA) is regarded as an ideal screening tool and is widely used in clinical diagnostics due to its simplicity, rapidity, user-friendliness and low cost[1,2]. In particular, during the COVID-19 pandemic, colorimetric lateral flow assay (especially gold nanoparticles based LFA) has demonstrated its convenience and superiority in personal home use[3]. However, lateral flow assay shows relatively low sensitivity due to short reaction time and insufficient sample processing (i.e. sample matrix colour interference). The application of nanoparticles with higher extinction coefficient (stronger light absorption capacity) is the most direct and simplest way to improve the sensitivity of lateral flow assay. Following this strategy, we rationally optimize the synthesis of gold and iridium oxide nanoflowers (Au-IrO_2 NFs) referring to De Freitas and co-workers' work[4] with modification by increasing the concentration of reduction reagent (2.5 mM sodium citrate) and decreasing reaction time. Specifically, we were able to rationally control their size (from 155 nm to 53 nm in diameter) in order to guarantee an optimal flow along the different pads of a LFA. Then, thanks to their superior plasmonic behavior (compared to standard AuNPs), we could achieve an 8-fold lower limit of detection (down to 1.7 ng/mL) for human immunoglobulin G (human IgG) than standard LFAs (13.5 ng/mL). And the Au-IrO_2 NFs based lateral flow assay can specifically identify the human IgG among various IgG from other hosts. Meanwhile, the Au-IrO_2 NFs based LFA showed acceptable recovery for detecting human IgG spiked in human serum (human IgG depleted). Therefore, due to their optical and redox properties, bioconjugation capabilities, and the synergic combination of the individual components, Au-IrO_2 NFs appear as potential candidates for the next generation of optical LFAs.

References

[1] Parolo, C., Sena-Torralba, A., Bergua, J. F., Calucho, E., Fuentes-Chust, C., Hu, L., Rivas, L., Álvarez Diduk, R., Nguyen, E. P., Cinti, S., Quesada González, & Merkoçi, A, Nature protocols, 15 (2020) 3788-3816.
[2] Brangel, P., Sobarzo, A., Parolo, C., Miller, B.S., Howes, P.D., Gelkop, S., Lutwama, J.J., Dye, J.M., McKendry, R.A., Lobel, L., Stevens, M.M., ACS Nano 12 (2018) 63-73.
[3] World Health Organization. 2020.
[4] De Freitas, I. C., Parreira, L. S., Barbosa, E. C. M., Novaes, B. A., Mou, T., Alves, T. V., Quiroz, J., Wang, Y. C., Slater, T. J., Thomas, A., Wang, B., Haigh, S. J., Camargo, P. H. C, Nanoscale 12 (2020) 12281-12291.

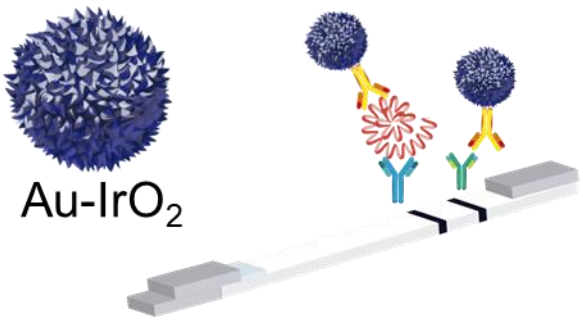

Figure 1: Scheme of Au-IrO2 nanoflowers based lateral flow assay