

SINGLE FLUOROPHORE AND RATIOMETRIC BIOSENSORS FOR PH AND UREA FOR DIAGNOSIS OF KIDNEY DISEASES

Dr. Abhijeet Joshi's TheraSens Laboratory

TheraSens Lab is working in the domains of biomedical engineering and pharmaceutical sciences. In a recent research report published in Nature Scientific Reports the group along with a research group at IIT Bombay has developed and tested a Fluorescein-isothiocyanate-dextran (FD)/FD-Urease encapsulated alginate micro-carriers as single/ratiometric fluorophore based fluorescent biosensors for detecting pH and urea in urine samples. Layer-by-layer self-assembly of polyallyl amine hydrochloride (PAH) and polystyrene sulfonate (PSS) in conjunction with Tris(bipyridine)ruthenium(II) chloride (RuBpy) over FD/FD-Urease loaded alginate microspheres aids in developing ratiometric sensors for pH and urea. FD and RuBpy function as indicator and reference fluorophores, respectively.

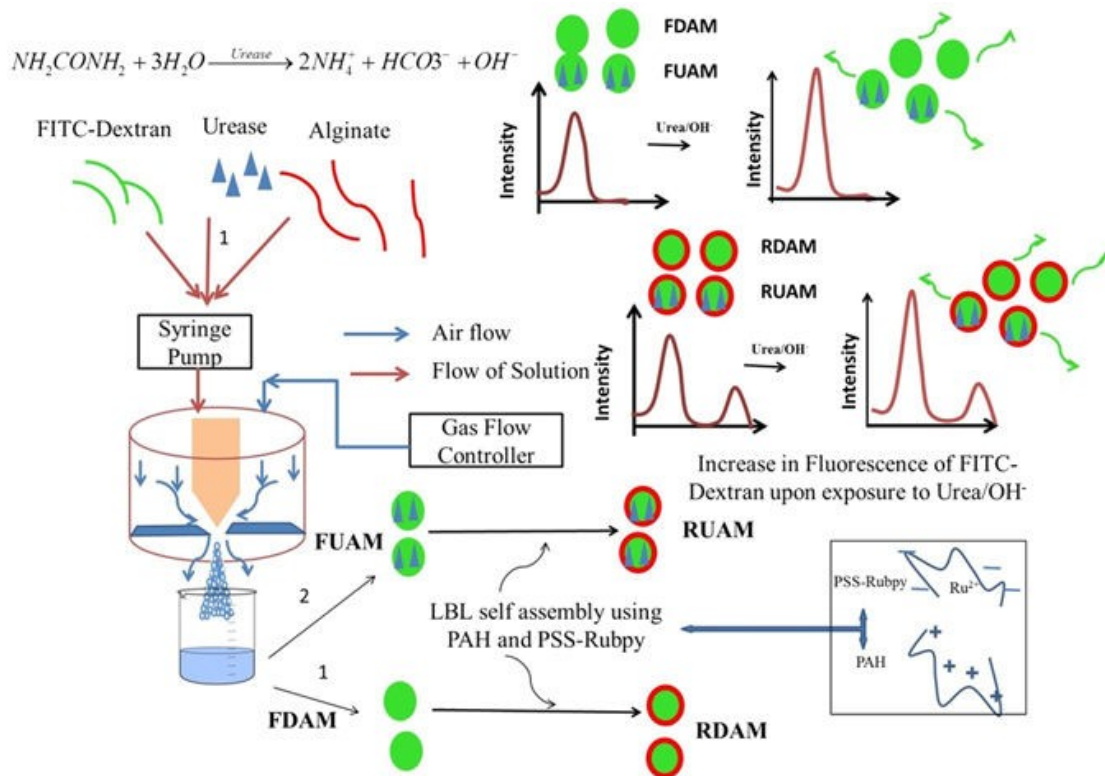


Figure: Schematic of development and mechanism of single fluorophore/ratiometric pH (Scheme 1) and urea biosensor (Scheme 2).

The developed biosensors were characterized using optical microscopy, zeta potential, SEM, CLSM and encapsulation efficiency and validated for accuracy, response time, linearity, range, intra-day/inter-day reproducibility, stability and performance in urine samples. Figure describes a schematic representation of production of single fluorophore and ratiometric pH and urea biosensors.

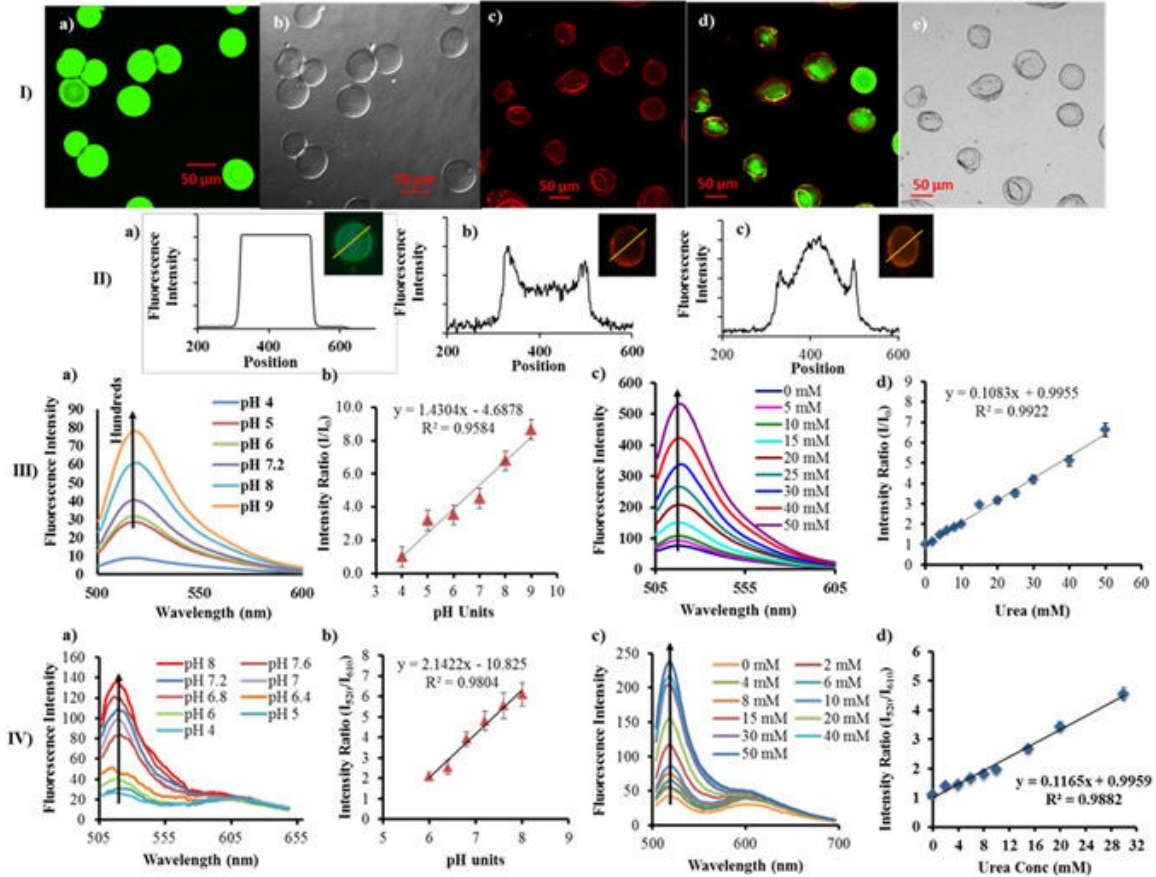


Figure: [I] Particle characterization of single fluorophore and ratiometric sensors using CLSM, and corresponding DIC images: (a,b) FDAM/FUAM, (c-e) RDAM/RUAM, [II] CLSM based line scan analysis of (a) FDAM/FUAM, (b) RuBpy loaded LBL assembled urease loaded alginate microspheres, (c) An overlay image of FD-RuBpy loaded microcarriers. [III] Single fluorophore based pH sensing (a,b) and urea sensing (c,d) and [IV] Ratiometric pH sensing (a,b) and urea sensing (c,d).

The findings suggest that the developed pH biosensor FDAM and RDAM show a detection capability in the range of pH units 6–8 and for urea biosensor FUAM and RUAM show sensing in the range of 0–50 mM. The analysis of biosensors (FDAM, RDAM, FUAM, RUAM) suggested that pH and urea detection is possible accurately with an accuracy of 95–104% in standard solutions. The results indicate that proposed biosensors have great potential to be translated to produce disposable biosensors for point-of care measurement. Our group is interested to translate such biosensor matrices into portable diagnostic kits. Any collaborators towards this aim can directly contact us.