Luminescence

Synthesis and characterisation of quantum dots coupled to mycolic acids as a water-soluble fluorescent probe for potential lateral flow detection of antibodies and diagnosis of tuberculosis

Kapambwe P. Kabwe[1], Sifiso A. Nsibande[1], Yolandy Lemmer[2], Lynne A. Pilcher[1], Patricia B. C. Forbes[1]

[1] Department of Chemistry, Faculty of Natural, and Agricultural Sciences, University of Pretoria, Pretoria, South Africa

[2] CSIR-Next Generation Health, Pretoria, South Africa

https://pubmed.ncbi.nlm.nih.gov/34813145/

Abstract

This work explores the potential use of cadmium-based quantum dots (QDs) coupled to mycolic acids (MAs) as a fluorescent probe to detect anti-MA antibodies which are biomarkers for tuberculosis (TB). The use of free MAs as antigens for the serodiagnosis of TB is known but has not been developed into a point of care test. This study focuses on the synthesis, solubility, and lateral flow of QDs coupled to MAs. Water-soluble CdSe/ZnS QDs capped with l-cysteine were synthesised and covalently coupled to MAs via amide linkages to form a water-soluble fluorescent probe: MA-CdSe/ZnS QDs. The MA-CdSe/ZnS QDs showed broad absorption bands and coupling, confirmed by the presence of amide bonds in the Fourier-transform infrared (FTIR) spectrum, resulting in a blue shift in fluorescence. Powder X-ray diffraction (XRD) revealed a shift and increase in the number of peaks for MA-CdSe/ZnS QDs relative to the L-cys-CdSe/ZnS QDs, suggesting that coupling changed the crystal structure. The average particle size of MA-CdSe/ZnS QDs was ~3.0 nm. Visual paper-based lateral flow of MA-CdSe/ZnS QDs was achieved on strips of nitrocellulose membrane with both water and membrane blocking solution eluents. The highly fluorescent MA-CdSe/ZnS QDs showed good water solubility and lateral flow, which are important properties for fluorescence sensing applications.