Fluorescence-based Fibre Optic Sensor for Hydrogen Sulphide Detection

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Hydrogen sulphide (H_2S) plays a significant role in biological processes [1,2]: while a normal concentration of H_2S is essential for physiological functions, a slight elevation can trigger diseases like cancer and Alzheimer [2-4]. Therefore, hydrogen sulphide detection has gained significant attention. Among conventional detection techniques including colorimetric measurement, chromatography, ion-selective electrode, and nanoparticles, the fluorescence-based detection method can offer a non-destructive and sensitive approach [2,3]. In this technique, the fluorescence of an indicator dye alters upon interaction with hydrogen sulphide.

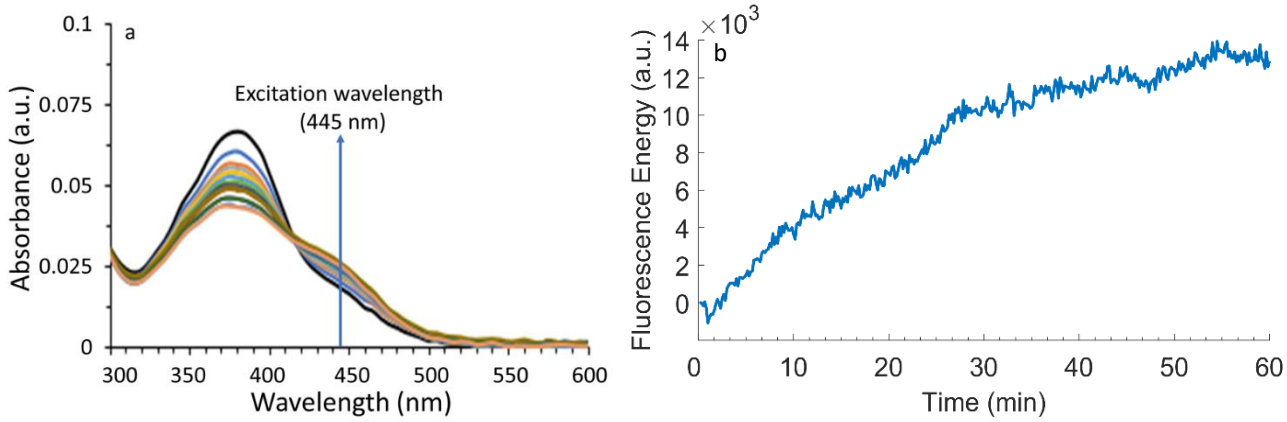

Fig.1: (a) Absorbance changes over time and an increase in the absorption at the excitation wavelength, and (b) changes in the fluorescence energy as a function of reaction time.

Here, we introduce a fluorescence-based fibre-optic sensor to detect hydrogen sulphide. Naphthalic azide as a fluorescent probe is coated on the tip of a multimode optical fibre. Upon reaction with hydrogen sulphide, the azide group will be reduced to amine and the fluorescence is altered. The fluorophore is excited by 445 nm laser light, and we demonstrate a time dependent increase in the intensity of the fluorescence emission when the probe is exposed to hydrogen sulphide. Fig.1(a) shows an increase in the absorbance of the H_2S-sensitive fluorophore over 30-minute reaction time with hydrogen sulphide in NaHS solution at 445 nm excitation. Fig. 1(b) depicts a preliminary result indicating the increase in the fluorescence emission energy for the same reaction but over a 1-hour period. The results confirm that the fluorophore attached to the optical fibre behaves similar to when it is dissolved in the solution for H_2S detection. Portability, miniaturization, high sensitivity, and minimally-invasiveness characteristics of the developed fibre optic sensor will make it an appropriate device for detecting hydrogen sulphide. We acknowledge the ARC Future Fellowship (FT200100154) funding for supporting this project.

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[3] Bu, D, et al. *Chinese Chemical Letters*, 32(5), pp.1799-1802 (2021).
[4] Zhou, Y, et al., *View*, p.20210008 (2022).