Single Fluorophore to Address Multiple Logic Gates

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Supplementary information

\[
A = A_0 + \frac{(A_f - A_0)}{2C_h} \left[ C_h + C_g + \frac{1}{K_a} - \left( \frac{(C_h + C_g + \frac{1}{K_a})^2 - 4C_hC_g}{2\sqrt{}} \right) \right]^{\frac{1}{2}}
\]

(S1)

Where \( A_0, A_f \) and \( A \) refer the absorbances of only DMAPIP-b, only \( \text{Fe}^{3+} \)-DMAPIP-b complex and any intermediate \( \text{Fe}^{3+} \) concentration with DMAPIP-b. \( K_a \) refers the \( \text{Fe}^{3+} \) binding constant of DMAPIP-b. \( C_h \) and \( C_g \) indicate the concentration of DMAPIP-b and \( \text{Fe}^{3+} \) respectively.

The self-absorption effect is corrected using the following equation and the corrected emission value (\( I_{\text{corrected}} \)) has been used for quantum yield calculation.

\[
I_{\text{corrected}} = I_{\text{observed}} \times 10^{\left(\frac{A_{\text{exc}} + A_{\text{em}}}{2}\right)}
\]

Membership Functions

A zmf can be represented as

\[
f(x;a,b) = \begin{cases} 
1, & x \leq a \\
1 - 2\left(\frac{x-a}{b-a}\right)^2, & a \leq x \leq a + \frac{b}{2} \\
2\left(\frac{x-b}{b-a}\right)^2, & a + \frac{b}{2} \leq x \leq b \\
0, & x \geq b
\end{cases}
\]

A trimf can be represented as follow.

\[
f(x;a,b,c) = \begin{cases} 
0, & x \leq a \\
\frac{x-a}{b-a}, & a \leq x \leq b \\
\frac{c-x}{c-a}, & b \leq x \leq c \\
0, & x \geq c
\end{cases}
\]

A smf can be represented as follow.
\[
f(x; a, b) = \begin{cases} 
0, & x \leq a \\
\frac{(x - a)^2}{2(b - a)}, & a \leq x \leq \frac{a + b}{2} \\
1 - \frac{(x - b)^2}{2(b - a)}, & \frac{a + b}{2} \leq x \leq b \\
1, & x \geq b
\end{cases}
\]

Fig. S1. Job’s plot for Fe\(^{3+}\)-DMAPIP-b complex (Emission monitored at 432 nm, due to the interfering of the DMAPIP-b emission at low mole fraction of [Fe\(^{3+}\)], those points are not included in the plot).

Fig. S2. Normalized excitation spectra of (a) DMAPIP-b, \(\lambda_{\text{em}} = 406\) nm and DMAPIP-b with 20 \(\mu\)M of Fe\(^{3+}\), (b) \(\lambda_{\text{em}} = 380\) nm, (c) \(\lambda_{\text{em}} = 560\) nm.
**Fig. S3.** Absorption spectra of (a) DMAPIP-b, (b) DMAPIP-b with 200 μM of Fe$^{3+}$, (c) DMAPIP-b with 200 μM of F$^-$, (d) DMAPIP-b with 200 μM of Fe$^{3+}$ and F$^-$. λ$_{exc}$ = 280 nm.

**Fig. S4.** Emission spectra of (a) DMAPIP-b, (b) DMAPIP-b with 200 μM of Fe$^{3+}$, (c) DMAPIP-b with 200 μM of F$^-$, (d) DMAPIP-b with 200 μM of Fe$^{3+}$ and F$^-$.
Fig. S5. Comparison of emission Spectra, (a) DMAPIP-b, (b) DMAPIP-b with 200 µM of Fe$^{3+}$, (c) DMAPIP-b with 200 µM of Fe$^{3+}$ and 200 µM of F$^-$. $\lambda_{exc} = 345$ nm.

References
