Chapter III

Fluorescence Characteristics of 5-Amino Salicylic Acid: A Probe for Iodide Detection
3.1 Introduction

The development of systems which are capable of sensing various biologically and/or chemically important negatively charged species is emerging as a research area of great importance [1-6]. One of the most attractive approaches in this field involves the advancement in optical sensors. A significant amount of work has been devoted to obtain specific chemo-sensors that are able to change (upon addition of the target species) one or several macroscopic properties in response. Changes in absorbance and fluorescence are the output signals mainly used in the development of optical sensors [7].

The determination and recognition of halides in the physiological environment is important because of their role in its functioning [8-10]. The determination of halide using fluorescence quenching is a popular technique because of high sensitivity of fluorescence and the simplicity of quenching reactions (where only a small volume of sample is required, the reactions are usually non-destructive and the reactions can be applied to almost any system that has an extrinsic or intrinsic fluorescent probe). Fluorescence quenching process has often, been considered for the sensing of halides from decades [11-16]. Particularly, in case of iodide, the explanation of this effect lies on the fact that the efficiency of intersystem crossing to the excited triplet state is enhanced (promoted by spin–orbit coupling) which depends on the mass of the quencher atom and hence the expression “heavy-atom effect” is sometimes used [17].

It is only recently the enhancement in fluorescence for the recognition of halides has gained interest [18-22] because the fluorescence can be detected nicely even for higher quencher concentrations when quenching may result in diminished intensity and can become prone to errors. A major limitation of the earlier projected quenching based iodide probes is that they only show a fluorescence-quenching signal upon interaction with iodide [23-26]. Moreover, the fluorescence quenching response usually results in low signal-to-noise ratio. Thus, from the analytical point of view, it is much more desirable to detect iodide by an enhanced fluorescence signal.

Iodide has unique chemical properties and its recognition/detection is of growing interest. As an essential trace element for human nutrition, iodine plays
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an important role in the development of brain functioning and cell growth [27].

Typically, iodine species, such as I\(^{-}\) and IO\(_3\)\(^{-}\), are absorbed from food and reduced to iodide (or remain as iodide) in the gastro-intestinal tract, where the absorbed iodide is considered as the main source of iodide for the synthesis of growth hormones. Lack of iodine leads to iodine deficiency disorder whereas excessive iodine dietary intake can result in serious pathological problems [28].

Although several classical analytical methods have been studied for iodine determination, most of them suffer from disadvantages, such as being discontinuous, time-consuming or requiring a cumbersome pre-treatment of the sample solution and a large sample amount required for analysis. With respect to the sensitivity, experimental simplicity and monitoring on-line, sensors have been proved to have advantages over the above methods [29].

Wolfbeis et al. reported the initial concept of fluorescent sensor for iodine based on dynamic fluorescence quenching of immobilized fluorophores by the analyte [30]. Since then there have been several reports on fluorescent iodine sensors and the quenching kinetics, which can be described by the various models [31-34].

To increase the selectivity and sensitivity, ratiometric measurements are utilized, which involve the observation of changes in the ratio of the intensities of the absorption or the emission at two wavelengths. Ratiometric fluorescent probes have the important feature that they permit better signal ratio and thus increase the dynamic range and provide built-in correction for environmental effects. The perceived colour change is useful not only for the ratiometric method of detection but also for rapid visual sensing. Hitherto, many investigations have been conducted to make ratiometric fluorescent probes for cations. In contrast, very few ratiometric fluorescent sensors for iodide have been found in literature. Thus, realization of ratiometric measurement for iodide is still a subject of interest [35-39].

In earlier studies it has been shown that 5- Amino Salicylic Acid (5-ASA) exhibits proton transfer reaction in excited state in aqueous medium [40, 41]. In the present work we have studied the interaction of 5-ASA (a potential drug for tuberculosis and bowel infection) in protic polar and aprotic polar medium and
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its interaction with iodide ion. Interestingly in aprotic solvents its fluorescence is enhanced despite iodine being a strong fluorescence quencher because of heavy atom effect. The interaction with iodide and subsequent increase in fluorescence is important from the following points of view (i) because of its medicinal importance and the presence of iodine in body fluids and (ii) sensing/recognition of iodide from the enhancement in fluorescence in physiological environments.

Scheme 3.1: Molecular structure of 5-Amino Salicylic Acid.

3.2 Results and discussion

The steady state and time domain parameters of 5-ASA in some aprotic and protic solvents are briefly given in Table 3.1 and 3.2.

The absorption spectra of 5-ASA in aprotic solvents viz dimethylformamide (DMF) and acetonitrile (ACN) show maximum at ~ 360 nm (Fig. 3.1) while in the emission spectrum, maximum is observed at ~ 463 nm (BG) for $\lambda_{ex} = 360$ nm (Fig. 3.2). The corresponding Stokes shift is ~ 6179 cm$^{-1}$. The excitation spectrum of 5-ASA in aprotic solvents was found to be independent of monitored emission wavelength and exhibits a single peak at ~350 nm (which resembles with its absorption spectrum). In aprotic solvents it is possible that N type of neutrals (scheme3.2) exist and most possibly these neutrals form intermolecular hydrogen bond (scheme3.2).
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Figure 3.1: Absorption spectra of 5-ASA ($3 \times 10^{-4}$ M) in aprotic solvent (a) ACNTL (b) DMF.

Figure 3.2: Emission spectra of 5-ASA($3 \times 10^{-4}$ M) in aprotic solvents (a) DMF and (b) ACNTL excited by $\lambda_{ex} = 360$ nm.
3.2. Results and discussion

However, in the excited state, these neutrals (N) can undergo excited state intramolecular proton transfer (Tautomer of N) resulting in large Stokes shifted emission [42] (scheme 3.2a) which emits at \(~ 463\) nm. In all the aprotic solvents studied fluorescence spectra are found to be independent of excitation wavelengths.

![Scheme 3.2](image)

**Table 3.1: Steady state parameters of 5-ASA in various solvents.**

<table>
<thead>
<tr>
<th>Solvent</th>
<th>$*\varepsilon$</th>
<th>$*\alpha$</th>
<th>$*\beta$</th>
<th>$\lambda_{\text{ab}}^{\text{max}}$ (nm)</th>
<th>$\lambda_{\text{em}}^{\text{max}}$ (nm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MeOH</td>
<td>25.3</td>
<td>0.83</td>
<td>0.77</td>
<td>303, 341</td>
<td>410, 470 (hump), 490</td>
</tr>
<tr>
<td>EtOH</td>
<td>24.5</td>
<td>0.86</td>
<td>0.75</td>
<td>306, 342</td>
<td>410, 470 (hump), 490</td>
</tr>
<tr>
<td>ACNT</td>
<td>38.0</td>
<td>0.19</td>
<td>0.40</td>
<td>360</td>
<td>463</td>
</tr>
<tr>
<td>DMF</td>
<td>36.7</td>
<td>0.00</td>
<td>0.69</td>
<td>356</td>
<td>470</td>
</tr>
<tr>
<td>THF</td>
<td>7.58</td>
<td>0.00</td>
<td>0.55</td>
<td>364</td>
<td>460</td>
</tr>
<tr>
<td>MeOH $+ \text{H}^+$</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>300</td>
<td>470</td>
</tr>
<tr>
<td>MeOH $+ \text{OH}^-$</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>340</td>
<td>490</td>
</tr>
</tbody>
</table>

$*\varepsilon, \alpha$ and $\beta$ are dielectric constant, hydrogen bond accepting and hydrogen bond donating parameters [47,48].
3.2. Results and discussion

Table 3.2: Fluorescence decay parameters of 5-ASA in different solvents.

<table>
<thead>
<tr>
<th>Solvent</th>
<th>$\lambda_{\text{ex}}$ (nm)</th>
<th>$\lambda_{\text{em}}$ (nm)</th>
<th>$\tau_1$ (ns)</th>
<th>$\alpha_1$</th>
<th>$\tau_2$ (ns)</th>
<th>$\alpha_2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>MeOH</td>
<td>320</td>
<td>410</td>
<td>2.64</td>
<td>0.92</td>
<td>7.91</td>
<td>0.08</td>
</tr>
<tr>
<td></td>
<td></td>
<td>440</td>
<td>3.15</td>
<td>0.75</td>
<td>8.10</td>
<td>0.25</td>
</tr>
<tr>
<td></td>
<td></td>
<td>470</td>
<td>4.00</td>
<td>0.51</td>
<td>8.28</td>
<td>0.49</td>
</tr>
<tr>
<td></td>
<td></td>
<td>500</td>
<td>4.72</td>
<td>0.30</td>
<td>8.52</td>
<td>0.70</td>
</tr>
<tr>
<td>ACNTL</td>
<td>360</td>
<td>420</td>
<td>6.67</td>
<td>0.78</td>
<td>11.58</td>
<td>0.22</td>
</tr>
<tr>
<td></td>
<td></td>
<td>450</td>
<td>6.73</td>
<td>0.84</td>
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<td>0.16</td>
</tr>
<tr>
<td></td>
<td></td>
<td>460</td>
<td>6.63</td>
<td>0.82</td>
<td>10.05</td>
<td>0.18</td>
</tr>
<tr>
<td></td>
<td></td>
<td>500</td>
<td>6.43</td>
<td>0.70</td>
<td>8.73</td>
<td>0.30</td>
</tr>
<tr>
<td>MeOH+OH⁻</td>
<td>320</td>
<td>440</td>
<td>6.60</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>470</td>
<td>6.67</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>500</td>
<td>6.68</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>520</td>
<td>6.68</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

* $\alpha$ ’s are relative amplitudes in percentage.

In MeOH, absorption maxima are observed around 300 nm and 340 nm. Triple fluorescence is observed at ~ 408 nm, ~ 480 nm and ~ 500 nm referred here as V, BG and G bands, respectively (Fig. 3.3). The excitation spectrum corresponding to V band shows a band with maximum around 300 nm whereas for BG band two peaks at ~ 310 nm (smaller) and 340 nm (bigger) are observed (Fig. 3.4). However, corresponding to G band, the excitation spectrum is red shifted with maximum around 340 nm. The corresponding Stokes shifts for $\lambda_{\text{abs}}$ = 300 nm are 8823, 12500, 13333 cm⁻¹ for V, BG and G bands, respectively. Similarly, the corresponding Stokes shifts for $\lambda_{\text{abs}}$ = 340 nm are 4902, 8578.5, 9412 cm⁻¹ for V, BG and G bands. The excitation spectra clearly reveal that V, BG and G emissions originate from different species. In earlier works [40, 41], it has been demonstrated that G band originates from anionic species hereby designated as A (scheme 3.3).
3.2. Results and discussion

Figure 3.3: Excitation spectra of 5-ASA (3 × 10^{-4} M) in MeOH at different emission wavelengths in methanol.

Figure 3.4: Emission spectra of 5-ASA (3 × 10^{-4} M) in MeOH at different excitation wavelengths in methanol.
3.2. Results and discussion

In analogy with ref. [40], the V band can be attributed to the species in which the amino group is intermolecularly hydrogen bonded and the carboxylic group is deprotonated (P type) as shown in (scheme 3.3a). In ref. [40], it has been established that absorption ~ 300 nm and emission at ~ 408 nm is due to zwitterions (protonated at the amino group and deprotonated at carboxylic group). However, in MeOH, it is unlikely that amino group can be protonated but the possibility of hydrogen bonding cannot be ruled out. Meanwhile it was observed that carboxylic group gets partially deprotonated in MeOH [43]. After ESIPT (which is very fast), the emission is observed at 410 nm. Now if we see BG emission at 470 nm, this emission should originate in neutral molecules (N), which are hydrogen bonded with the oxygen of MeOH as the emission is observed, around the same position (of course with some shift) as in case of aprotic solvents. This is possible in MeOH as it has both hydrogen donating and accepting capabilities.
3.2.1. Addition of KI (aprotic solvents)

The decay parameters of 5-ASA in different solvents are given in table 3.2. For aprotic as well as protic solvents the decay fits with biexponential function. In case of ACN two decay components of 6.3 ns and 9.5 ns are observed whereas in DMF these two components are 7.74 ns and 12.63 ns. Broad emission coupled with two decay components indicates that there are two emitting species. ESIPT coupled with charge transfer (CT) can be evoked to explain the broad emission with biexponential decay [44].

3.2.1 Addition of KI

3.2.1.1 In aprotic solvents:

Steady state and time resolved study of 5-ASA in aprotic solvents in the presence of various concentration of iodide ion ($I^-$) were performed at room temperature.

Interestingly, on keeping the solute concentration fixed and increasing the $I^-$ ion concentration, hypsochromic as well as hyperchromic effect in the absorption spectra is observed (Fig. 3.5). In DMF, the absorption maximum is shifted from ~360 nm to ~340 nm while their corresponding optical density (O. D.) increased from ~0.60 to ~0.75 (Fig. 3.5). Similar behavior has also been observed in ACN. The change in absorption with addition of $I^-$ ion indicates that there is complexation between $I^-$ and 5-ASA.

To know the nature of complex we have plotted $1/\Delta A$ (where $\Delta A$ represents a change in absorbance with and without KI) versus inverse of iodide concentration (Benesi-Hildebrand plot) which is shown in fig. 3.6. The linear relationship indicates that the complex is 1:1 in nature. It can be mentioned here that the excitation spectra also reflect similar change as observed in case of absorption. Interestingly, in ACN, four fold and in DMF two fold enhancements in the fluorescence intensity is observed with increasing concentration of $I^-$ (Fig. 3.7 and 3.8). In addition to enhancement, a small red shift in fluorescence spectra is observed for the highest $I^-$ concentrations taken in the study.
3.2.1. Addition of KI (aprotic solvents)

Figure 3.5: Absorption spectra of 5-ASA ($3 \times 10^{-4} M$) in DMF in presence of [I$^-$].

Figure 3.6 Benesi-Hildebrand plot for 5-ASA in ACNTL.
3.2.1. Addition of KI (aprotic solvents)

![Emission spectra of 5-ASA (3×10⁻⁴ M) in ACNTL in presence of [I⁻]](image)

**Figure 3.7:** Emission spectra of 5-ASA (3×10⁻⁴ M) in ACNTL in presence of [I⁻]

<table>
<thead>
<tr>
<th>Solvent</th>
<th>Concentration KI [M]</th>
<th>τ₁ (ns)</th>
<th>τ₂ (ns)</th>
<th>*α₁</th>
<th>*α₂</th>
<th>#χ²</th>
<th>&lt;τ&gt; (ns)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACNTL</td>
<td>0</td>
<td>6.30</td>
<td>9.51</td>
<td>0.80</td>
<td>0.20</td>
<td>1.01</td>
<td>6.94</td>
</tr>
<tr>
<td></td>
<td>6X10⁻⁴</td>
<td>6.42</td>
<td>9.54</td>
<td>0.61</td>
<td>0.39</td>
<td>1.05</td>
<td>7.64</td>
</tr>
<tr>
<td></td>
<td>1X10⁻³</td>
<td>6.44</td>
<td>9.63</td>
<td>0.52</td>
<td>0.48</td>
<td>1.02</td>
<td>7.97</td>
</tr>
<tr>
<td></td>
<td>4X10⁻³</td>
<td>6.43</td>
<td>10.00</td>
<td>0.34</td>
<td>0.66</td>
<td>1.07</td>
<td>8.79</td>
</tr>
<tr>
<td></td>
<td>8X10⁻³</td>
<td>6.44</td>
<td>10.28</td>
<td>0.24</td>
<td>0.76</td>
<td>1.07</td>
<td>9.36</td>
</tr>
<tr>
<td></td>
<td>2X10⁻²</td>
<td>6.28</td>
<td>10.31</td>
<td>0.12</td>
<td>0.88</td>
<td>1.16</td>
<td>9.83</td>
</tr>
<tr>
<td></td>
<td>6X10⁻²</td>
<td>6.32</td>
<td>10.82</td>
<td>0.11</td>
<td>0.89</td>
<td>1.30</td>
<td>10.33</td>
</tr>
<tr>
<td></td>
<td>1X10⁻¹</td>
<td>6.33</td>
<td>10.91</td>
<td>0.10</td>
<td>0.90</td>
<td>1.00</td>
<td>10.45</td>
</tr>
<tr>
<td>DMF</td>
<td>0</td>
<td>7.74</td>
<td>12.63</td>
<td>0.28</td>
<td>0.72</td>
<td>1.08</td>
<td>11.26</td>
</tr>
<tr>
<td></td>
<td>6X10⁻⁴</td>
<td>7.68</td>
<td>12.65</td>
<td>0.23</td>
<td>0.77</td>
<td>1.11</td>
<td>11.51</td>
</tr>
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<td></td>
<td>1X10⁻³</td>
<td>7.71</td>
<td>12.58</td>
<td>0.20</td>
<td>0.80</td>
<td>1.05</td>
<td>11.61</td>
</tr>
<tr>
<td></td>
<td>4X10⁻³</td>
<td>7.73</td>
<td>12.72</td>
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<td>1.08</td>
<td>12.32</td>
</tr>
<tr>
<td></td>
<td>8X10⁻³</td>
<td>-</td>
<td>12.83</td>
<td>-</td>
<td>1</td>
<td>1.09</td>
<td>12.83</td>
</tr>
<tr>
<td></td>
<td>2X10⁻²</td>
<td>-</td>
<td>13.11</td>
<td>-</td>
<td>1</td>
<td>1.07</td>
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<td>-</td>
<td>13.31</td>
<td>-</td>
<td>1</td>
<td>1.02</td>
<td>13.31</td>
</tr>
</tbody>
</table>

* α’s are relative amplitudes in percentage, and # χ² for double exponential decay.

Table 3.3: Fluorescence decay parameters of 5-ASA in aprotic solvents with increasing concentration of I⁻ ion at λₑₓ = 360 nm, λₑₘ = 460 nm.
3.2.1. Addition of KI (aprotic solvents)

The observed enhancement in fluorescence intensity can also be viewed directly and is shown in Fig. 3.9. The enhancement as well as red shift in emission is an indication of hydrogen bonding [45] of the carboxylic hydrogen with I⁻.

Figure 3.8: Emission spectra of 5-ASA (3x10⁻⁴ M) in DMF in presence of [I⁻].

Figure: 3.9 Fluorescence in ACN (a) in the presence of [I⁻] and (b) in the absence of [I⁻].
3.2.2. Addition of KI (Protic solvents)

For the sake of convenience we define intensity enhancement factor (IEF) given by \( I / I_0 \) where \( I_0 \) and \( I \) are intensities in the absence and presence of \( I^- \) respectively. A plot between IEF and \([I^-]\) for ACN and DMF is depicted in Fig. 3.10.

To investigate the effect of \( I^- \) concentration, transient experiments were carried out. The decay data are summarized in Table 3.3 and the increase in decay time is depicted in Fig 3.11. In ACN, it is interesting to note that the longer component shows an increase (\( \tau_2 = 9.51 \text{ ns to } 11.42 \text{ ns} \)) with the addition of \( I^- \) under the considered concentration range. However, the shorter component (\( \tau_1 = 6.30 \text{ ns} \)) does not change significantly. Of course, the amplitude corresponding to \( \tau_1 \) goes on decreasing with addition of \( I^- \).

This increase in longer component can be attributed to the stronger hydrogen bond formation between the carboxylic hydrogen of 5-ASA and \( I^- \). It is to be noted that intermolecular hydrogen bonding stabilizes the tautomer (T) as reported in earlier studies [45, 46]. At the same time the decrease in the amplitude of the shorter component indicates that with addition of \( I^- \) charge transfer (CT) may be prohibited. Similar behavior is observed in DMF. Also, in DMF for higher (1\( \times 10^{-1} \) M) concentration the decay becomes mono-exponential indicating that CT type of species are not present after this concentration. This indicates that at higher iodide concentration interaction of \( I^- \) results in decreased CT character in 5-ASA. Again the increase in longer decay component can be attributed to stabilization of the tautomer (T). The photo-cycle for 5-ASA in aprotic in presence of KI is proposed in scheme 3.4.

3.2.1.2 In protic solvents

As mentioned earlier, in protic polar solvent (MeOH), two absorption bands are observed, one at 300 nm and another at 340 nm. On addition of \([I^-]\), the absorption band at 300 nm diminishes and a band develops at 340 nm (Fig. 3.12). At the highest concentration of studied \( I^- \) ion only a single absorption band at 340 nm is observed (Fig. 3.12).
3.2.2. Addition of KI (Protic solvents)

Figure 3.10: Plot of $I/I_0$ (IEF) versus $[I]$ in aprotic solvents.

Figure 3.11: Decay profiles and corresponding residuals for 5-ASA in ACNTL in the presence of $[I]$ at 0 M (a), $10^{-2}$ M (b), $10^{-1}$ M (c) [$\lambda_{ex} = 360$ nm and $\lambda_{em} = 460$ nm].
3.2.2. Addition of KI (Protic solvents)

In the emission spectrum, at $\lambda_{ex} = 320$ nm, on increasing the concentration of $\Gamma^-$ ion, the V band diminishes in intensity and the G band shows an enhancement (Fig. 3.13).

Figure 3.12: Absorption spectra of 5-ASA in MeOH ($3 \times 10^{-4}$ M) in presence of [Γ].
3.2.2. Addition of KI (Protic solvents)

It is interesting to see that the G band gains in intensity with I⁻ whereas V band starts diminishing and finally at higher I⁻ concentrations it appears as a small hump. A plot of intensity ratio of G to V band ($I_G / I_V$) with iodide concentration is made (Fig. 3.14). Using least-square fit method, our experimental data fit well with a linear equation. (Fig. 3.14) and the correlation coefficient is found to be near unity. The change in intensity as well as colour on addition of I⁻ in MeOH can be easily viewed with naked eye as shown in Fig. 3.15.

Further, the decay behavior shows some interesting features. At 410 nm (maximum of V band), the decay fits with a bi-exponential function with components $\tau_1 \sim 2.64$ ns and $\tau_2 \sim 7.91$ ns (Table 3.4). With increase in I⁻ concentration, $\tau_1$ as well as $\tau_2$ do not show any considerable change. However, the amplitude corresponding to $\tau_1$ decreases significantly whereas the amplitude corresponding to $\tau_2$ increases. This clearly rules out any excited state reaction (as decay times are almost constant with the addition of (I⁻). However, the decrease in the amplitude along with the decrease in the intensity of V band, suggests that P type of species (producing V emission) decrease in number and at the same time more anions (A) are formed at the cost of P type of molecules. At 500 nm the fluorescence decay again fits with biexponential function with decay components of $\tau_1 \sim 4.72$ ns and $\tau_2 \sim 8.52$ ns.

Interestingly again the decay components do not show any appreciable change but exhibit change in amplitudes. This indicates that the concentration of anion increases with the addition of I⁻ as is also evident from the increase in the intensity of G band. This also rules out the possibility of presence of water in iodide, as in water the observed decay time is shorter [40]. Thus it clearly shows that more anions are produced at the cost of P type of conformers (scheme 3.3).

It can be noted that recently fluorescence enhancement was projected for the detection of iodide [18]. However in probes used by have metals like Hg and Cu linked with organic molecules for the detection of iodide as the probes work on redox mechanism [18].
3.2.2. Addition of KI (Protic solvents)

Figure 3.13: Emission spectra of 5-ASA (3×10⁻⁴ M) in MeOH in presence of [I⁻] at λ_ex=320 nm.

Figure 3.14: Plot of I_G/I_V versus [I] in protic (MeOH) solvent.
3.2.2. Addition of KI (Protic solvents)

Figure 3.15: Fluorescence in MeOH (a) in the absence of \([I^-]\) and (b) in the presence of \([I^-]\).

Table 3.4: Decay parameters of 5-ASA in protic solvent (MeOH) with increasing concentration of \(I^-\) ion at \(\lambda_{ex} = 320\) nm.

<table>
<thead>
<tr>
<th>(\lambda_{em}) (nm)</th>
<th>([I^-]) M</th>
<th>(\tau_1) (ns)</th>
<th>(\tau_2) (ns)</th>
<th>(*a_1)</th>
<th>(*a_2)</th>
<th>#(\chi^2)</th>
<th>(&lt;\tau&gt;) (ns)</th>
</tr>
</thead>
<tbody>
<tr>
<td>410</td>
<td>0</td>
<td>2.64</td>
<td>7.91</td>
<td>0.92</td>
<td>0.08</td>
<td>1.11</td>
<td>3.06</td>
</tr>
<tr>
<td></td>
<td>5X10^-4</td>
<td>2.87</td>
<td>7.88</td>
<td>0.91</td>
<td>0.09</td>
<td>1.01</td>
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* \(a\)'s are relative amplitude in percentage.

# chi-square values for double exponential decay.
3.3 Conclusion

Present system appears to be important in the sense that it does not contain any metallic element and hence is expected to be free from any toxic effect. It is also important to mention that other halides e.g. Cl\(^-\) and Br\(^-\) are rather poorly soluble in these aprotic solvents, which makes this system attractive for sensing dissolved iodide in aprotic media. In the same token the present study demonstrates the role of iodide as fluorescence promoter rather than quencher for which it is generally known.

Finally, we feel that IEF in case of aprotic medium and use of ratiometric analysis in protic medium can be projected to sense iodide. Such molecular system appears to be interesting in iodide recognition/sensing in biological environments.

3.3 Conclusion:

The present study establishes the presence of various conformers and ionic species in 5ASA depending on the protic/aprotic nature of the solvent. The study demonstrates enhancement in intensity in the presence of iodide in aprotic solvents whereas in protic media more anions are produced. The present system appears to be quite useful in sensing/recognition of iodide ion in various biological environments.
3.4 References:

3.4. References

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