Environment effect on the electronic absorption spectra of Malachite Green

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Introduction

Triarylmethane dyes (TAM⁺) are a class of compounds that have a variety of industrial and medical applications. They have long been used as colorants in the dye industry. Their medical use to treat transfusion blood against Chagas disease is noteworthy. Recently, it has been demonstrated that this group of dyes enhance photo-reactivity. In order to understand better its chemical and photochemical properties in complex chemical and biological systems, it is necessary to understand in detail the effect of the environment on its spectroscopy and physiochemical properties.

Key words: triarylmethane dyes, concentration effect, Solvatochromic behavior

Materials and methods

Malachite Green oxalate, a cationic dye, was obtained from Merck (pro-analysis) and used without further purification. Fig. 1 displays the structure of this dye. All the solvents with high purity were purchased from Merck. The absorption spectra of the ionic dye in organic solvents were scanned using a Cary UV-Vis double beam spectrophotometer (Model 100).

Figure 1. Molecular structure of Malachite Green
Result and discussion

The analysis of how solvent properties and dye concentration affects the electronic spectra of this trisarylmethane (TAM⁺) dye was performed on the basis of two spectroscopic parameters namely the difference in wave number (Ou) and wavelength of the maximum absorption (Fig 2). It is clear that there is a relationship between Ou and the values of a, ḳ and n*. The values of the Solvatochromic parameters (n*, a, ḳ) and the dielectric constants (s) were obtained from Ref.3

Selected Kamlets- Taft’s Solvatochromic parameters ḳ, a, n*, with electric permittivity for the solvent used, taken from Refs. 3

<table>
<thead>
<tr>
<th>solvent</th>
<th>Electric permittivity, ε</th>
<th>ḳ</th>
<th>a</th>
<th>n*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetone</td>
<td>20.56</td>
<td>0.48</td>
<td>0.08</td>
<td>0.71</td>
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<tr>
<td>Acetonitrile</td>
<td>35.94</td>
<td>0.31</td>
<td>0.19</td>
<td>0.75</td>
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<tr>
<td>Ethanol</td>
<td>24.55</td>
<td>0.77</td>
<td>0.83</td>
<td>0.54</td>
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<tr>
<td>Water</td>
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<td>0.18</td>
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<tr>
<td>DMSO</td>
<td>46.7</td>
<td>0.76</td>
<td>0.00</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Figure 2. visible absorption spectrum of MG in the different isotropic solvents

Conclusion

The Solvatochromic behavior of dyes determined by is the shift of the absorption maximum wavelength (Zmax) due to the presence of solvents with different polarity, which is due to the interaction between the solute and solvent molecules.
References
