Mixing Diagnostics for Formation of Byproducts

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Concept

Formation of Byproduct (FOB)

\[ A + B \rightarrow C \text{ (desired)} \]

\[ C + B \rightarrow D \text{ (byproduct)} \]
Concept

- Metal ion Nickel(II) react with ligand 2,2’-bipyridine to form complexes

- Complexes with different coordination numbers have different colors

- Model of formation of byproduct (FOB) is set
Concept

• Requirements for FOB model

• All chemicals should be safe and cheap
• Reaction time should be considered
• Great color difference between the product and the byproduct
Reactions

• \( \text{Ni}^{2+} + \text{Bipy} \rightarrow \text{Ni(Bipy)}^{2+} \) (blue)

• \( \text{Ni(Bipy)}^{2+} + \text{Bipy} \rightarrow \text{Ni(Bipy)}_2^{2+} \) (purple)

• \( \text{Ni(Bipy)}_2^{2+} + \text{Bipy} \rightarrow \text{Ni(Bipy)}_3^{2+} \) (red)
Reactions

Ni(II) + BIPY $\rightarrow$ 1:1

1:1 + BIPY $\rightarrow$ 1:2

1:2 + BIPY $\rightarrow$ 1:3
Experimental

• Make up 0.200 M Nickel Sulfate 30% (v/v) Ethanol solution

• Make up 0.200 M 2,2’- Bipyridine 30% (v/v) Ethanol solution

• Mix them with different ratios
UV-vis absorption of 0.200 M Ni(II) with 0.200 M Bipy in 30%(v/v) Ethanol with different ratio

- 1:3, 521.5 nm, Abs. = 0.912
- 1:2, 552.8 nm, Abs. = 0.803
- 1:1, 597.2 nm, Abs. = 0.707
CIELAB Analysis

LA = 60.09, a = 7.44, b = 7.55 Grid = 10.0 / 1.0
Mixing Process
Advantages of the FOB Model

• Nickel sulfate and Bipyridine are safe and cheap

• Easy to tell the complexes color (blue, purple, red)

• Easy to control reactions (reaction time longer than 30 seconds)
Conclusion

• System of Nickel bipyridine complexes is a good model for the formation of byproducts
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