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Luminescence Properties of a Dysprosium(III) Complex

Lanthanide complexes can have interesting applications in lasers, organic light-emitting diodes (OLEDs), and medical imaging applications. While the luminescence properties of Eu^{3+} and Tb^{3+} have been well-studied, less is known about the energy emissions of Dy complexes. The literature article "Synthesis, Structure, Photoluminescence, and Electroluminescence Properties of a New Dysprosium Complex" by Li et al discusses the luminescence properties of the dysprosium complex $\text{Dy}(\text{PM})_3(\text{TP})_2$, and its potential for use in electroluminescent devices. Read through the article on your own, then discuss and answer the following questions with your group.

- 1) Write a complete and balanced equation for the synthesis of $\text{Dy}(\text{PM})_3(\text{TP})_2$.

- 2) What is the coordination number for $\text{Dy}(\text{PM})_3(\text{TP})_2$? Is that what you would expect? Explain.

- 3) Sketch the electron configuration and give the ground-state term symbol (including J) for the dysprosium ion in $\text{Dy}(\text{PM})_3(\text{TP})_2$.

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4) Construct a Jablonski (energy) diagram for $\text{Dy}(\text{PM})_3(\text{TP})_2$ and attach to this assignment. Include values for energy levels where possible (based on what is given in the article).

5) How many total states does the ground state split into based on spin-orbit coupling? How does this correlate with the experimental emission spectrum for $\text{Dy}(\text{PM})_3(\text{TP})_2$ given in the article? Explain.

6) What is Dexter's theory? Evaluate $\text{Dy}(\text{PM})_3(\text{TP})_2$ in the context of Dexter's theory, and discuss how it compares with Tb^{3+} and Eu^{3+} complexes. Why is this analysis useful, particularly for Dy^{3+} ?

7) The authors conducted tests to determine the photoluminescent and electroluminescent properties of $\text{Dy}(\text{PM})_3(\text{TP})_2$. Briefly define photoluminescence and electroluminescence, and discuss why the authors are interested in these properties (e.g. potential applications).