**Ultrafast Electron Localization Dynamics Following Photo-Induced Charge Transfer**

Please complete these guiding questions to the journal article *Science,* **2000**, *289*, 935-938. DOI: [10.1039/c3cs35510a](file:///C:\Users\topaz\Documents\VIPEr%20LOs\Braunschweig%20ACS%202024\10.1039\c3cs35510a)

This literature discussion celebrates Dr. James McCusker for being the recipient of the Josef Michl ACS Award in Photochemistry 2024 from the American Chemical Society. The award citation reads: “*For contributions to the understanding of the photoinduced properties of transition-metal complexes through the combined use of synthesis and ultrafast spectroscopy.*”

[insert Scheme 2 from the article here]

1) In this report, the authors studied the photo-induced metal-to-ligand charge transfer in [Ru(bpy)3]2+ using femtosecond time-resolved absorption spectroscopy. These types of processes are similar to those found in photosynthetic centers.

a) Write the full name of the bpy ligand and draw it.

b) What does the prefix “femto-“ mean in “femtosecond”?

2) Apply the Covalent Bond Classification method to fill in the table below for [Ru(bpy)3]2+.

|  |  |
| --- | --- |
|  | [Ru(bpy)3]2+ |
| bpy CBC ligand classification |  |
| [MLlXxZz]Q± classification |  |
| MLlXxZz equivalent neutral class classification (if applicable) |  |
| Valence number / oxidation state |  |
| Ligand bond number |  |
| Electron count from ligands |  |
| Electron count from metal |  |
| Total electron count |  |
| dn count for metal |  |

3) In Scheme 2, the authors give three possible pathways in which the photo-induced metal-ligand charge transfer from Ru to one of the bpy ligands can occur. Path (a) involves the intrinsic delocalization; path (b) shows the transferred electron localized on one of the bpy ligands; path (c) is the formation of the localized intermediate from an intrinsically delocalized intermediate. A key feature of being able to distinguish between these pathways is the symmetry of the two excited state species in Scheme 2.

a) The point group of [Ru(bpy)3]2+ is *D3*. Use the <https://symotter.org/gallery> to list two other compounds with the same symmetry.

b) List the symmetry elements in the *D3* point group.

c) Which of these symmetry elements is no longer present as a result of the reduction of one of the bpy ligands to form [Ru(bpy¯)(bpy)2]2+, resulting in a *C2* point group?