

# Dye Design: The Road to More Efficient Dye-sensitized Solar Cells

The endeavor to find cheap, renewable, and abundant energy to meet humanity's power demands today and in the future has become one of the most urgent tasks of modern times. A natural place to look for energy would be the powerhouse of our solar system: the Sun. The Sun's energy in the form of solar rays holds immense potential to meet global energy demands well into the future as it produces 10,000 times more energy on earth's surface than what is used today. Dye-sensitized solar cells are devices that absorb sunlight and convert it into electricity with the help of dyes, which in our case is based on transition metal complexes, which consists of molecules (ligands) that are arranged around a central metal ion.

Electrons are stable subatomic particles with a negative charge that can be found in all atoms and molecules. When the Sun's light reaches the dye, some of the energy will be absorbed and this energy will make a certain electron in the dye jump up to a higher energy level and a portion of this energy can be contributed by the electron as electrical energy by leaving the dye and entering the circuit in a dye-sensitized solar cell, which creates an electron-hole in the dye in the process. Sometimes however, this electron may recombine with the dye immediately to fill the electron-hole it left behind, and not contribute to any energy harvesting, which hurts the efficiency of the dye-sensitized solar cell. To combat this problem, we have used ligands that could be used in a push-pull design, where one part of the dye tries to push (donate) electrons while another part tries to pull (accept) electrons when light is absorbed. This is done to increase the electron density in a location in the dye that facilitates an easy exit for the electron so it can convert electricity, but also to prevent the electrons from entering the complex again to neutralize the electron-hole that it left behind. In my work, I have contributed to this research field by creating novel ligands that can be used in these push-pull designs and I have complexed them with iron(II) as the central metal ion.