An Ideal Color System for Polymer Science with Polydiacetylenes

by

Dr. Nan - Loh Yang's group

Dr. Min-Hui Cui

Dr. Dayi Xu

Mr. Chong Cheng

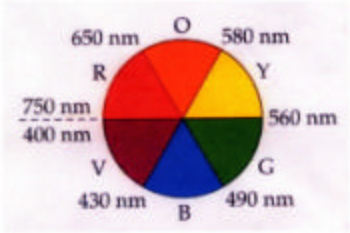
In Association with

Polymer Science Department

College of Staten Island

(CSI -CUNY)

COLOR WHEEL



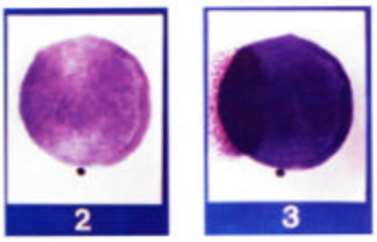
Color wheel showing:

1) **Colors those are complementary to each other. If polymer absorbs green, you will see it as complementary color (red);**

2) **The wavelength range of each color. Since energy is inversely proportional to wavelength. Colors with shorter wavelength have higher energies e.g. violet has greater radiant energy in comparison to red.**

Step 1. Sample Preparation for Polymerization

Use pipette to add several drops of monomer solution on a piece of filter paper, and then dry it to form thin, colorless coating of crystalline monomer, which is ready for polymerization



Blue Color
Planar and Compressed

2 Partly polymerized PP4BCMU
Conjugated backbone polymer

3 Deeply polymerized PP4BCMU
Highly conjugated backbone polymer

Slightly heat the blue colored coating of PP4BCMU. A blue to red irreversible color change takes place.

- **The solid solution (A) is destroyed. The polymer chains are released. Now the dislodged polymer (B) chains are of a stretched and deformed conformation.**
- **p-Electrons are moving over 10 to 20 repeat units. The polymer molecules absorb at shorter wavelengths and appear red.**

Yellow

Heat the red colored coating to above 145 °C, the coating will turn to yellow

- **Above 145 °C, the hydrogen bonds among the polymer chains break, and the backbone rotates along the single bonds, thus acquiring a nonplanar conformation, and the polymer appears yellow;**
- **Upon cooling to room temperature, the hydrogen bonds are reformed, and the polymer chains return to the planar conformation and hence recover the red color.**

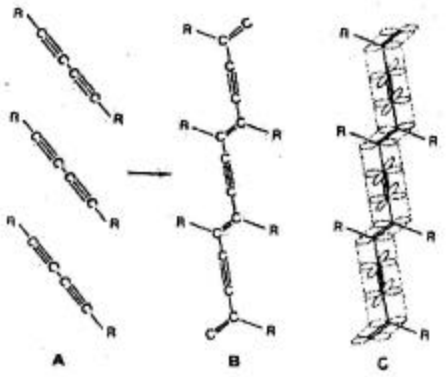


Figure 1. Structures of diacetylenes and their polymers: A, Monomer; B, Polymer; C, Overlapping of the π orbitals of the conjugated backbone. In some cases the backbone can acquire a butatriene structure

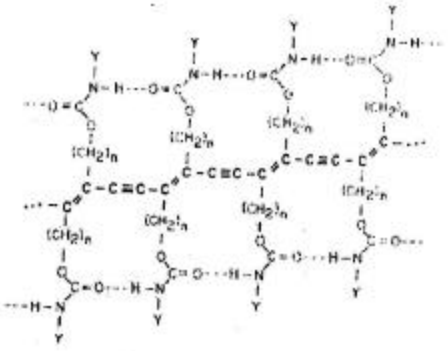


Figure 2. Hydrogen bonded conformation of urethane substituted polydiacetylenes

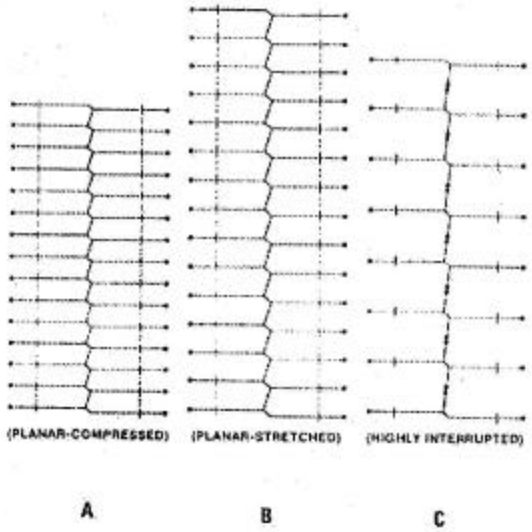


Figure 3. Some important conformation of urethane substituted polydiacetylene: Backbone: central zigzag line; hydrogen bonds: two vertical dotted lines; side groups: horizontal solid lines; substituent Y: heavy dots