University of Fribourg / Faculty of Science and Medicine / Department of Chemistry

Bioinspired Stimuli-Responsive Color-Changing Systems

Golnaz Isapourlaskookalayeh

The remarkable ability of certain animals and plants to change color in response to environmental conditions has inspired scientists, philosophers, artists and legends throughout history. Chameleons, cephalopods, beetles and butterflies are some of the well-known examples of spontaneous color-changing found in Nature. For decades, the effort has been to understand the underlying mechanism of such unique characteristics, mimic them and develop materials with similar behavior. Technological advancements in characterization of materials and manufacturing methods have enabled us to develop practical applications for such materials.

The overall objective of this PhD thesis is to develop bio-inspired structurally-colored materials with the ability to change colors in response to external stimuli. *3D* photonic crystals made of temperature, pH and magnetic field responsive particles, and Bragg multilayer reflectors made of elastomers were prepared as the basic optical elements.

Temperature and pH-responsive polymer microgels were used to develop color-changing systems inspired by iridophores present in the chameleon's skin.

A novel concept was developed to create materials with magnetically-responsive color-changing abilities. The mechanism was inspired by the pigment displacement ability of chromatophores present in the cephalopods' skin.

Elastomeric Bragg reflectors in the fiber geometry were inspired by the seed coat of Margaritaria nobilis fruits. An optical fiber was used to develop a wavelength tunable laser.

Future plans to improve the developed systems, obstacles and potential applications were discussed at the end of each part of the work.

Jury:
Prof. Dr. Marco Lattuada, *Thesis supervisor*
Prof. Dr. Andreas Kilbinger, *Internal examiner*
Prof. Dr. Harm Anton Klok , *External examiner*
Prof. Dr. Fabio Zobi, *President of the jury*