FUNCTIONAL SUPRAMOLECULAR CHEMISTRY

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This lecture will focus on synthetic organic, molecular and supramolecular systems with significant activities. Emphasis is on the integration of underrecognized or even new concepts to get into contact on the molecular level, in the hope that fundamentally new approaches to create function will ultimately allow us to tackle challenges that are otherwise beyond reach. One topic of interest concerns catalysis with unorthodox interactions. This was realized first with anion-π interactions and then expanded to chalcogen, pnictogen and tetrel bonds. Today, several reactions have been realized, including enolate, enamine, iminium and Diels-Alder chemistry. The most recent natural product inspired polyether cascade cyclizations are particularly attractive for autocatalysis on π-acidic surfaces, to show the pnictogen-bonding catalysts are more than just weak Lewis acids, and to develop lipid bilayer membranes as unique environment for catalysis. Other catalytic systems explored in this context include small molecules but also foldamers, carbon nanotubes, artificial enzymes, and even electric fields.

The same chalcogen bonds are also the key to build mechanosensitive fluorescent probes that change color like lobsters during cooking. The imaging of physical forces in living cells is a central challenge in biology, and the resulting "flipper probes" have been shown to provide the chemistry tools needed to image to membrane tension by FLIM. Examples will move from design and synthesis to intracellular targeting by empirical tracking, genetic engineering, and photocaging, with illustration of pertinent biological questions related to tension-induced microdomain assembly, mitochondrial division, plasma membrane asymmetry, endocytosis and the secretory pathway. As a final topic, dynamic covalent exchange chemistry will be introduced as the key to find new ways to enter cells. Thiol-mediated uptake will the covered as the emerging method of choice to deliver directly into the cytosol, explain the mystery of cell-penetrating oligonucleotide phosphorothioates, and develop new strategies to inhibit viral entry. This growing significance of thiol-mediated uptake calls for "walker-like" dynamic covalent cascade chemistry with bioinspired epidithiodiketopiperazines, benzopolysulfanes, cyclic thiosulfonates, pnictogen relays and tetrel-centered Michael and thiolactone exchangers.

CV (just from my web page):

Stefan Matile is a Full Professor in the Department of Organic Chemistry at the University of Geneva, a founding member of the National Centre of Competence in Research (NCCR) Chemical Biology and a founding member of the NCCR Molecular Systems Engineering. In 2010, he became an ERC Advanced Investigator, in 2017 an SNSF Level-1 Investigator. He is the co-author of more than 350 publications, many in top journals (61 JACS, etc), and has delivered more than 290 lectures all over the world. About half of the more than 100 junior researchers he has trained so far (PhD, postdoc) are now active in academia (Lithuania, China, France, Germany, India, Italy, Japan, Spain, South Korea, USA, etc); others preferred a career in industry (Firmenich, Nestle, DuPont, Siegfried, BASF, Roche, Novartis, JT, etc), or elsewhere. Educated at the University of Zurich (PhD, with Wolf Woggon) and Columbia University in New York (postdoc, with Koji Nakanishi), he started his independent academic career as an Assistant Professor at Georgetown University, Washington DC, before moving to Geneva.