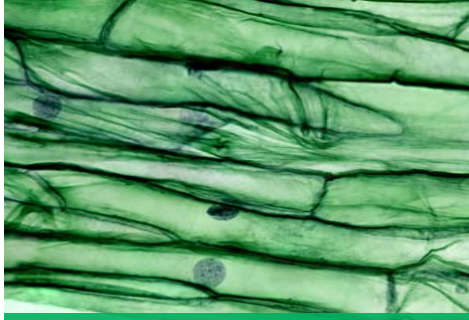
Environmental protection

Given the extensive development of industrialization and urbanization, safeguarding the environment poses a significant challenge for both current and future generations. Scientists at I2BC are actively investigating the molecular mechanisms that underlie organisms' adaptive responses to environmental pressures. Additionally, they are exploring the processes involved in converting solar energy into chemical energy, specifically in the context of biofuels. Through these research endeavors, I2BC is committed to providing solutions aimed at mitigating or even reversing the adverse impacts of past, present and future human activities on our environment.

Photo credit: Ilan Zirina, AdobeStock

Environmental protection



Exploring new approaches to pollution remediation

To address pollution-related concerns, with a particular focus on heavy metals, petroleum hydrocarbons, and radionuclides, we are actively developing innovative removal and sequestration techniques. Our efforts include:

- The reprogramming of photosynthetic organisms and bacteria by:
  - characterizing the mechanisms behind heavy metal and radionuclide accumulation and sequestration[1-3]
  - utilizing microfluidic platforms to analyse the uptake of heavy metals in plant roots[4-7]
  - investigating isolated microorganisms from extreme environments[3,8]
  - employing genetic engineering tools, like modified retrotransposable elements (targetrons) with programmable genetic specificity[9]
  - developing a micropilot-scale bioprocess for the depollution of metals and radionuclides from industrial and nuclear effluents[10]
- The bioproduction of various minerals, including those with magnetic properties, for use in bioremediation (i.e. radioactive waste)[11,12]

Exploring novel pathways for the bioproduction of valuable molecules

In our pursuit of economically viable and environmentally friendly compounds, including biofuels, we are actively developing biotechnological and bio-inspired processes.

- We reprogram photosynthetic organisms[13] by:
  - characterizing natural photocatalytic processes, such as enzymatic photo-decarboxylation of fatty acids[14]
  - optimizing regulatory mechanisms governing photosynthetic electron transport in response to abiotic stress, like high light or drought, in cyanobacteria, green algae and plants[15] to improve light-dependent production of biomolecules
- We develop bio-inspired artificial (photo)catalysts[16,17], particularly for harnessing solar energy, for production of combustible fuels[18] and other molecules of interest[19].

Fields of expertise

- Physiology, metabolism and biophysics of archaea, cyanobacteria, microalgae and plants
- Physical, analytical and inorganic chemistry
- Photochemistry
- Photo- and electro-catalysis
- Synthetic biology

Technical skills

- Forward and reverse genetics
- Genome engineering
- Multi-Omics
- Elucidation of photoreaction mechanisms
- ATPmetry
- Chlorophyll fluorescence analysis
- Fluorescence and electron microscopy (TEM, SEM, CryoEM)
- ICP-MS elemental analyses
- Flow cytometry
- Microfluidics and root chip fabrication
- Spectroscopy and time-resolved optical spectroscopy
- Spectro-electrochemistry
- Structural prediction and modeling of multimolecular complexes
- Calculation, storage, use of bioinformatics software (development of workflows, data processing), online tools and services.

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