Sandia National Laboratories

Energy, Climate & Infrastructure Security

Biofilms Laboratory

The Biofilms Laboratory conducts both basic research and application testing with connections to Sandia's Energy, Climate and Infrastrcuture Security (ECIS) strategic management unit.

Vision

To enhance the nation's security and prosperity through sustainable, transformative approaches to our most challenging energy, climate, and infrastructure problems.

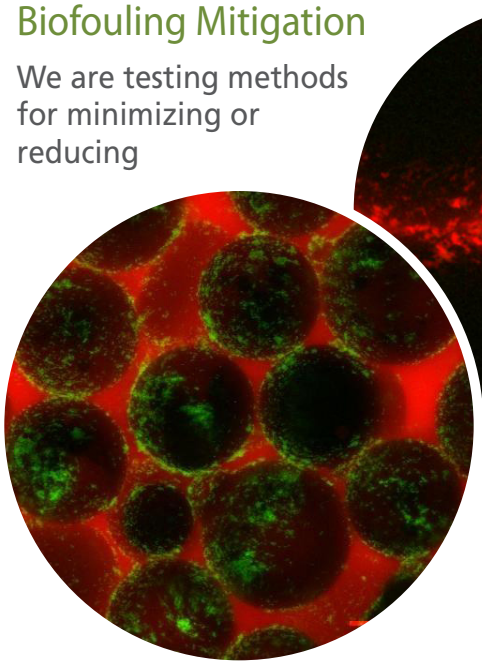
For example, research on the impact of carbon storage on the subsurface biological environment is connected to the Climate Program Area by contributing research for the reduction of carbon emissions. Development of biofouling resistant water-treatment membranes will assist in creation of more energy efficient and lower-cost water supplies. In addition, research focused on mitigating biofouling is connected to the development of more efficient hydrokinetic renewable energy, thus assisting in increasing the use of low carbon, economically viable energy sources. The research conducted in the Biofilms Laboratory is divided into the following three areas:

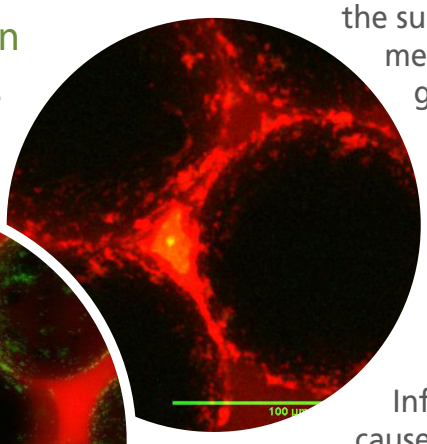
Biofouling Mitigation

We are testing methods for minimizing or reducing biofouling. Research to date has focused on both water-treatment membranes and devices for alternative hydropower. We are also teaming with modelers to help with the design and analysis of our testing.

Impacts of Microbiology on Subsurface Flow and Transport

The biological impacts on subsurface geochemistry, flow and transport need to be incorporated in subsurface energy applications. Compressed air energy storage, geothermal, and other low-carbon power generation sectors can benefit from increased awareness and control of subsurface microbiology. This understanding is also important for safe and secure storage of carbon in the subsurface as a means to decrease greenhouse gas emissions.





Water Distribution System Safety

Infectious diseases caused by pathogens are a drinking water health risk. Research is needed to examine the interaction between pathogens and biofilms on the drinking water pipe surfaces. Our

U.S. DEPARTMENT OF ENERGY

Spiral wound membrane testing system.

research is aimed at answering questions such as:

1. If a biological pathogen is introduced into a drinking water system will it become integrated in the biofilms on the pipe-wall surfaces
2. Once integrated into the biofilms, how long will the pathogens persist in the biofilms, and
3. Can the biofilms protect the pathogens from disinfection, or will traditional disinfection methods be able to remove the pathogens.

Facilities

Our facilities have the capabilities to conduct general microbiological studies and the necessary testing of our technologies:

Biofilm growth and measurement:

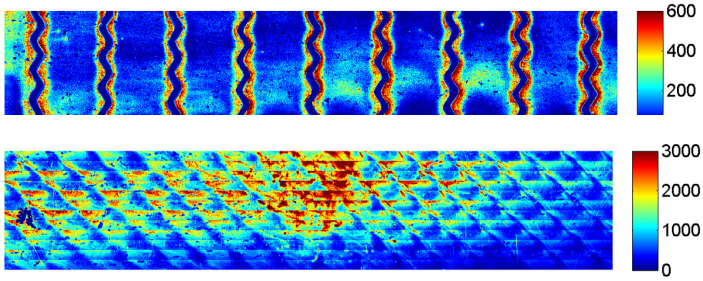
- » CDC, drip-flow and annular biofilm reactors
- » Cell enumeration

Biofilm imaging:

- » Epifluorescent microscopy
- » Confocal microscopy
- » Hyperspectral imaging with multivariate curve analysis

- Biofilm cryosectioning
- Cross-flow membrane testing
- Spiral wound membrane testing
- Computation fluid dynamic modeling

The researchers have expertise in microbiology, geochemistry, molecular biology, organic and polymer chemistry, biochemistry, hydrology and computational fluid dynamic and geochemical modeling.



Use of micromixers (dark blue chevrons on top image) to control location and amount of biofouling (red) as compared to a membrane without micromixers (bottom).

For more information please contact:

Susan Altman
E-mail: sjaltma@sandia.gov
Phone: (505) 844-2397

Mark Rigali
E-mail: mjrigal@sandia.gov
Phone: (505) 284-2727

Website: energy.sandia.gov

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