Reducing Cutting Artifacts During Cryo-sectioning

Brandeis University/NSF

Team Members:

Scott Carlson, Danielle Dougherty, David Gardner, Leah Mendelson, Alex Niswander, John Rosenwinkel, Jacob West

Faculty Advisor:

Dr. Brian Storey

Sponsor Liaison:

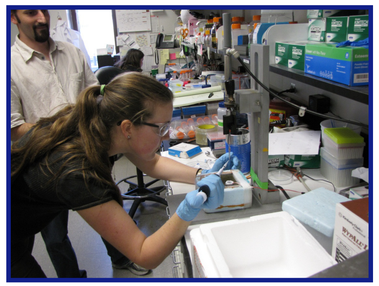
Dr. Daniela Nicastro

SCOPE
Senior Capstone Program in Engineering

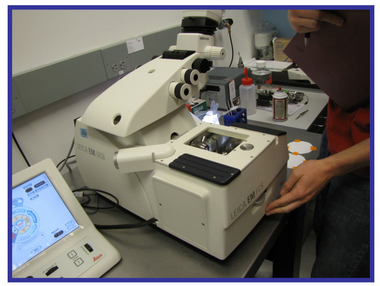
Lab Goal:

The Nicastro lab at Brandeis University is working to produce a life-like image of the 3D structure inside cells and tissues through the process of cryo-sectioning.

Process:



Freeze sample



Shave sections with the cryo-ultramicrotome

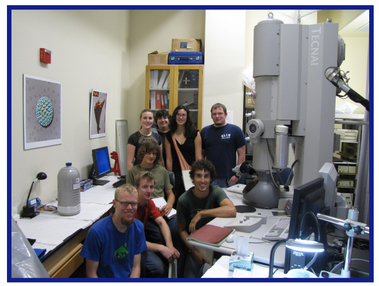
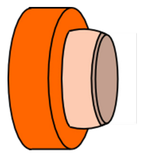
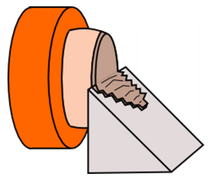


Image using Transmission Electron Microscopy (TEM)

The Problem:

The sample must be sectioned below 140K or ice crystals will form. Cutting to imageable thickness with the cryo-ultramicrotome (200 nm) for the TEM leaves artifacts (deformations and crevasses) on the cryo-sections and final image.





SCOPE Project:

Develop a new mechanism to eliminate cutting artifacts when sectioning cellular tissue while preserving the sample.

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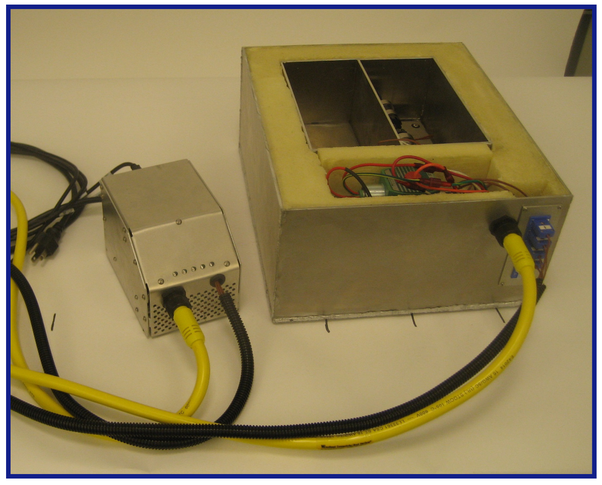
Challenges:

- Cryogenic conditions
- Localized temperature control
- Nanometer sample thickness
- Usability

Process:

- Initial research about cryo-sectioning
- Ideation of possible solutions
- Build a test rig for initial questions
- Design and manufacture of two prototypes



Results:

The final prototype will be used by researchers in the Nicastro lab to prepare samples. The device includes a mechanism to manipulate the sample that can be operated by one user. The prototype also includes a high-precision temperature control system to protect the sample.