# Production of Deuterated Polymer Thin Films for Ion-Beam Fusion Experiments

Kallah Eddy, Ethan Nagasing, Ethan Smith, Kurt Fletcher, Steven Padalino

State University of New York at Geneseo

## Abstract

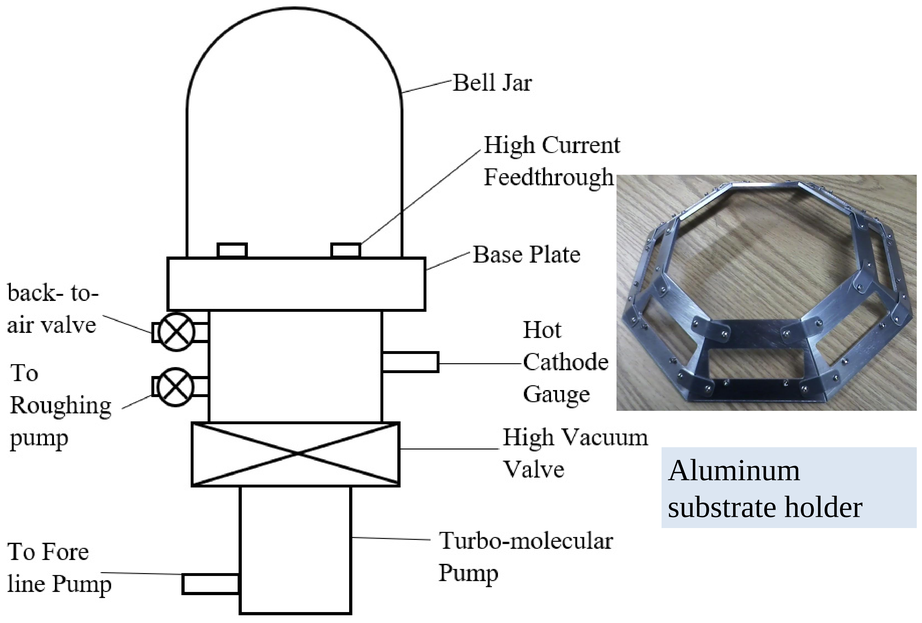
At ion-beam facilities such as the 1.7 MV Pelletron Accelerator and the 30 kV Duoplasmatron ion source at SUNY Geneseo, deuterated polyethylene thin films are bombarded by deuterons, producing fusion products to characterize inertial confinement fusion detection systems. A refurbished thin films deposition system is being commissioned to produce the deuterated polymer targets via thermal evaporation. The high vacuum system for the 18-in diameter bell jar includes a turbomolecular pump and associated valves and gauges. Deuterated polyethylene powder is placed in a tantalum boat located in the center of the bell jar and attached to high-current feedthroughs. Films are deposited on commercially obtained glass slides treated by a release agent and covered with 10 μg/cm$^2$ carbon films; the slides are positioned above the deuterated polymer source on an octagonal mount uniquely designed to hold the slides 8 inches from the source, normal to the incoming material, and 30 degrees from the vertical. A rate deposition monitor is used to monitor the film thickness during deposition. After the desired thickness is obtained, the films can be mounted on target rings using the floating technique.

## Motivation

Thin films are used as targets for our ion-beam experiments using the Duoplasmatron and 1.7 MV Pelletron. The refurbished thin films evaporator will

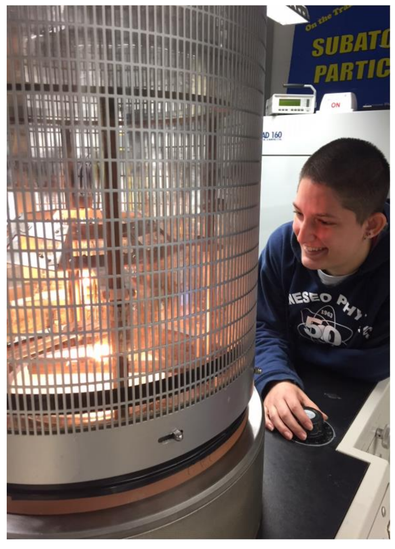
be used to fabricate these films for inertial confinement fusion-related studies. In particular, thin films of deuterated polyethylene are used for fusion experiments.

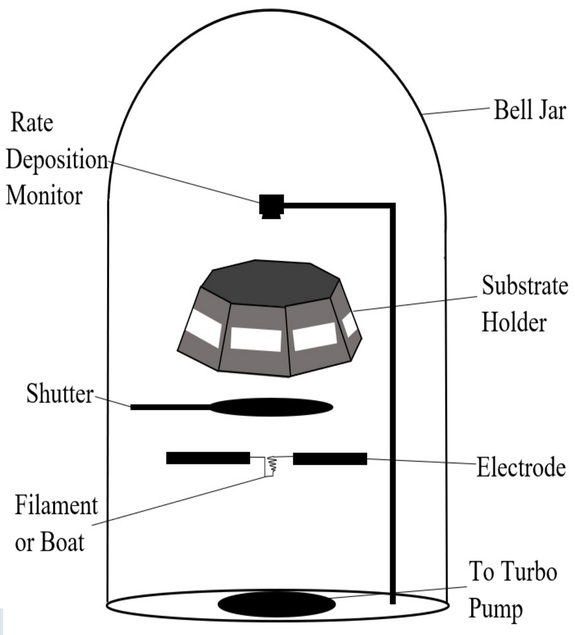
## Experimental Setup



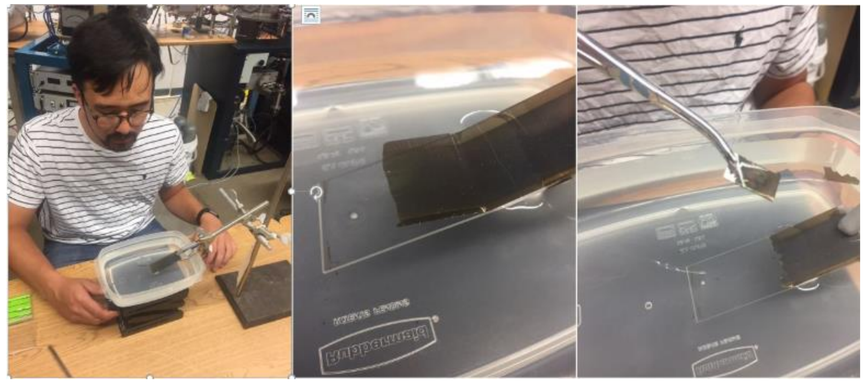



Aluminum substrate holder






The floating technique is used to produce thin film targets



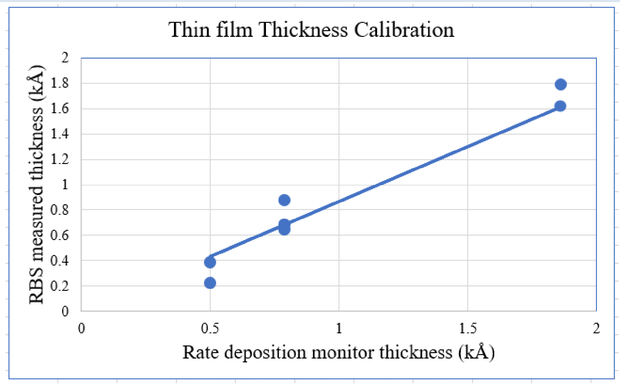
## Procedure

- Aluminum films were deposited at three different thicknesses (0.5 kÅ, 1.0 kÅ, and 2.0 kÅ) using aluminum pellets in a tungsten basket
- Deuterated polyethylene was deposited at a thickness of 4.0 kÅ for ion beam targets.

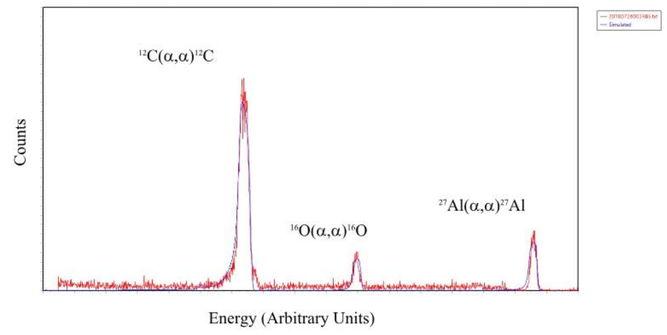
In both cases, the films were deposited on glass microscope slides coated with a release agent and 10 μg/cm$^2$ carbon films.

## Results

To calibrate the rate deposition monitor, the thicknesses of aluminum films from three depositions were determined using Rutherford Back Scattering of 3.6 MeV alpha particles produced by the Geneseo 1.7 MV Pelletron accelerator.




Rutherford Backscattering Spectrum




The solid line in the calibration graph is the Rate Deposition Meter (RDM) measurement multiplied by the Cosine of 30°. Since the RDM sensor is directly above the sample and the substrates are oriented at 30° from the vertical, this curve is the expected calibration curve and shows good agreement with the measurements, although additional data are needed.

## Acknowledgements

Funded in part by a grant from the DOE through the Laboratory for Laser Energetics.