

Enabling direct reaction studies with small, highly radioactive samples

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Direct reaction studies on radioactive samples

Chemistry

Instruments, Infrastructure and Execution

Sample Production









DICER Instrument

Experiments

hotLENZ Instrument

- For (n,z) studies
- ⁵⁶Ni sample e-plated on thin Au foil
- Custom tungsten instrument cask
- Remote operations

os Alamos



Kinematic / mount/alignment system

Sample position

Tungsten instrument cask

- For (n,tot) studies
- Simultaneous sample in-out measurement
 - Ø1mm binocular collimation, 30m long system
 - "Thick" samples for transmission measurements
- ⁸⁸Zr sample in 2M DCI D₂O solution
- Self shielding hermetic sample container



Chemistry

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- Remote operations in hot cells
- Chemical separation of irradiated production target, fab prep
- Identification and quantification of sample material and contaminants
- Speed and efficiency of operations









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Aqueous solution Ø1mm x 10mm

Tungsten container Ø10mm x 15mm

⁸⁸Zr

Sample Considerations



Ø6mm deposition

hotLENZ ⁵⁶Ni



- Sample form factor
 - Thin platings
 - Aqueous solutions
- Sample material location
 - Limited material
 - Production
 - Dose considerations
 - Beam/target overlap critical
- Neutronics •
- Chemical compatibility •





Los Alamos

Custom self-locating e-plating gasket

Automated microliter dispensing system

Sample Production

- Remote operations in hot cells
- Sample production techniques
 - Electroplating
 - Hermetically sealed
- Packaging and transport





On-board inspection



Assembly fixture and cover Over the road transport basket

Instruments, Infrastructure and Execution

⁵⁶Ni with hotLENZ @ WNR

- Facility-flightpath-instrument optimization
 - Holistic approach to design
 - Modern metrology→T4Gen2
 - Advanced collimation
 - Precision alignment
- Safety
 - Radiation safety
 - Remote operations
 - Shielding
 - Cold runs







Instrument cask



Instruments, Infrastructure and Execution













Cask is inside chamber



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Sample holder and collimator, Ø1mm binocular style with 15m focal point

Instruments, Infrastructure and Execution









Direct reaction studies on radioactive samples

- Fully integrated multidisciplinary effort
 - Systems engineering approach to design, integrate, and manage complex systems
 - Precise coordination of intricate operations across multiple teams
 - This methodology delivers the required speed and efficiency, but....
- <u>Safety is paramount</u>
- Direct reaction studies on many short lived radioactive isotopes is within reach!



