Silicon Withdrawal System

Quartz Liner System Design

- **Problem**
  - Possible breakage of quartz liner during thermal cycle

- **Design Criterion**
  - No silane should be allowed to flow in between quartz liner and stainless steel reactor wall
Quartz Liner for FBR

1. HYDROGEN EXHAUST
2. HYDROGEN INLET
3. DIFFERENTIAL PRESSURE GAGE
4. CLAMSHELL HEATER
5. THERMOCOUPLE
6. PYROMETER
7. SILICON CARBIDE HEATER
8. PISTON
9. PNEUMATIC CYLINDER
10. SILANE INLET
11. NITROGEN INLET
Quartz Liner After Exposure to Silane Pyrolysis
SILICON MATERIAL

Purity Experiment

• SEED PARTICLES WERE PREPARED VIA JET MILL GRINDING OF 2 TO 4 mm SIZE SOLAR GRADE SILICON PARTICLES PURCHASED FROM THE DYNAMITE NOBEL

• EXPERIMENTAL CONDITIONS
  • AVG. SEED PARTICLE SIZE: 254 μm (+106 to -425 μm)
  • INITIAL BED WEIGHT: 9 kg (≈ 21" BED HEIGHT)
  • U / Umg: 5
  • SILANE CONCENTRATION: 30% (IN H2)
  • BED TEMPERATURE: 650°C
  • DURATION OF RUN: 4 hrs
  • PARTICLES WERE WITHDRAWN AT 2 hr INTERVALS EQUIVALENT TO PRODUCTION RATE

• MASS BALANCE
  • SILICON DEPOSITED ON THE PARTICLES IN BED: 99%
  • SILICON RECOVERED AS FINES: 7.2%

• PRODUCTION RATE: 1.7 kg/hr

Purity of Silicon

• EMISSION SPECTROSCOPY WAS USED ONLY TO ESTABLISH IF ANY GROSS CONTAMINATION WAS CAUSED DURING SEED PREPARATION AND FLUIDIZED BED PROCESSING

• PURCHASED SILICON PARTICLES AND SEED MATERIAL FOR FBR HAVE METALLIC CONTAMINATIONS BELOW THE DETECTION LIMITS OF EMISSION SPECTROSCOPY, SUCH AS Fe = 30 ppmw, Cr = 8 ppmw, AND Ni = 10 ppmw

• PURITY DATA DO NOT SHOW ADDITIONAL METAL CONTAMINATIONS IN THE PRODUCT SILICON. HOWEVER, IT DOES NOT MEAN THAT FBR PRODUCT IS OF SOLAR OR SEMICONDUCTOR GRADE

• WORK IN PROGRESS
  • NEUTRON ACTIVATION ANALYSIS
  • PULL A SINGLE CRYSTAL SILICON INGOT
  • MAKE RESISTIVITY MEASUREMENTS
SEM Photographs of FBR Product (650°C, 30% SiH₄, 4 h); Deposition = 17 μm
Jet Mill for Silicon Seed Particle Preparation
SILICON MATERIAL

Recent Publications

- A paper titled "FINES IN FLUIDIZED BED SILANE PYROLYSIS" was published in The J. of Electrochemical Society, March 1984.

- A paper titled "FLUIDIZED BED SILICON DEPOSITION" was presented to the 17th IEEE PV Specialist Conference, Florida, May 1-4, 1984.