



Silicon Material

CEA INES

SUSI platform

Location of the infrastructure :	Le Bourget du Lac, France	(specific website, or webpage if any)
Contact person :	Anis Jouini	Phone : + 33 4 79 60 19 40 E-mail : anis.jouini@cea.fr

Objectives :	<ul style="list-style-type: none">• Crystallisation and wafering processes• Silicon ingot and wafer characterisation
Main features :	<ul style="list-style-type: none">• Crucible processing with coating equipments and firing furnaces. The maximum size for the crucible is 420*420*300 cm³, corresponding to a 60kg ingot (G2). This activity is localised in a temperature and humidity-controlled area, in order to guarantee the representativity and the stability of the coating.• Crystallisation equipments with both inductive and resistive furnaces, and both conduction and radiation heat extraction. Two furnaces are available but collaborations on the 450-800kg furnace from ECM technologies, located at INES, are possible. Various software like FLUENT and COMSOL are used for the modelling of the furnaces.<ol style="list-style-type: none">1. An inductive furnace from Cyberstar (10kg), with a radial induction coil and a heat extraction by conduction. This furnace can produce circular ingots of 10kg, which corresponds to 1 brick of 125*125 mm²2. A resistive furnace from TIV (60kg), close to the design of industrial furnaces, with a resistor at the top and bottom of the crucible, and the possibility to add a lateral resistor if necessary. This furnace is fully instrumented, with gas analysis, high temperature endoscopic visualisation, variation of partial pressure atmosphere, and both heat extraction by conduction and radiation. The crucible size of 60kg allows the production of 4 bricks of 156*156 mm²• Slicing tools with all the facilities to go from 60kg ingots to wafer with thickness down to 100µm. This step includes the cleaning facilities for bricks and wafers as well as grinding and chamfering.• Characterisation equipments:<ol style="list-style-type: none">1. ICP-MS from Agilent : ppb resolution for B, P and metallic elements analysis in Si feedstock,2. MEB-FEG NovaSEM 630 from FEI (1.6 nm resolution) including EBIC and STEM analysis3. A metallographic area, including all the facilities for polishing and a cross section polisher (ion beam). All acid attacks for silicon are possible. Last generation optical microscopy including visualisation at 1500°C is also available.4. Electrical characterisation of ingots and wafers. Most of the equipments are available : Resistivity measurement, hall effect, Semilab (wafer and brick), Sinton, PVSCAN, LID test bench, LBIC, FTIR, IR brick measurement,...)
Limitations or constraints :	The access will be allowed with technical and scientific assistance from INES. For the crystallisation process, the experiments will be realised by INES technical staff.
Typical services or results :	Silicon feedstock both electronic grade and metallurgical grade can be provided if necessary. Most of these equipments are new, as this laboratory started its activity recently. They provide an ideal environment for crystallisation studies on various substrates and in various crucibles.
Examples of research projects :	Fundamental and experimental studies focused on silicon crystallization and comprehensive description of defects in silicon material