

Attachment 1: List of collaborative use equipment

Equipment are classified into three categories for the ease of handling:

A : For authorized person only

B : At least one authorized person must present

C : Not specified

Equipment name	Purpose of Use	Note	Standard and Regulation for Use	Notices
Transmission type electron microscope (LaB6-TEM)	Metallographic observation, STEM	JEM-2100plus, Accelerating voltage:200kV resolution:0.19nm(TEM)	A	
Transmission type electron microscope (FE-TEM)	HRTEM, WB-STEM, STEM-EDS	JEM-ARM 200F, Accelerating voltage:200kV resolution:0.10nm(TEM) 0.14nm (STEM)	A	Equipment personnel and the necessary consultation
FIB with a scanning type electron microscope (Dual beam) Plasma cleaner	Microfabrication of the sample Surface cleaning of the sample for TEM	FEI Quanta 200 3D, with a scanning type electron microscope Fischione Plasma Cleaner Model 1020	A	Equipment personnel and the necessary consultation
			B	
Electrolytic polishing apparatus	Electrolytic polishing of the metal sample for TEM	Tenupol-3,5Voltage:5 - 120V, Electric current:5 - 16A	B	
Gentle Mill	Surface cleaning of the sample for TEM	GENTLE MILL IV, Accelerating voltage:200V-120kV,	A	
Thin film sample preparation apparatus, Ion slicer	Thinning of the sample by Ar ion sputter	JEOL EM-09100IS Ion slicer, Accelerating voltage 1 - 8kV	A	

Three dimensional atom probe	Three dimensional mapping of atom	CAMECA LEAP-4000XHR, with Laser pulse auxiliary, Local electrode type	A	Equipment personnel and the necessary consultation
Sample preparation electrolytic polishing apparatus for Three dimensional atom probe	Electrolytic polishing of the metal sample for 3D-AP	DC power supply(0-20V)	B	
Positron lifetime measurement device	Observation of Micro defect/Micro precipitates		A	
Positron annihilation Doppler broadening measuring device	Observation of Micro defect/Micro precipitates	Coincidence formula	A	
Slow positron beam	Observation of Micro defect in the vicinity of the sample surface	Only Doppler broadening measurements (lifetime measurement is not allowed)	A	Equipment personnel and the necessary consultation
Temperature-programmed desorption test equipment	Hydrogen isotopes in a materials, release behavior of He etc., Evaluation of absorption	Test temperature, room temperature:-1000°C, Qmass:MKS Microvision2 1-6	A	
Vickers micro hardness testing machine	Hardness measurement of material and fuel	Shimadzu Corporation	C	

Nanoindenter	Micro region(sub - Several hundred μm)Hardness measurement system	Elionix ENT-1100a	A	
Instrumented Charpy impact test machine	Measurements of the ductile - brittle transition temperature	Takes Group 1.0m/s~5.0m/s, (1.0-10.0)mm, Square sample	A	
Fatigue testing machine	Fatigue test	INTESCO 200kgf 7x10 ⁵ Pa, room temperature - 700°C	A	
Tensile testing machine	Mini size only tensile	IINTESCO Vacuum high temperature(- 700°C), Max:200kg	B	
Tension and compression testing machine	Mini size only tension and compression	INTESCO Low-Normal temperature, Max:200kg	B	
Vickers micro-hardness testing machine	Material, hardness measurement of fuel	Matsuzawa MMT-X test load (5 ~ 1000gf)	B	

Heat treating furnace	Vacuum heat treatment of the sample piece	~ 1000 °C, 2x10 ⁻⁴ Pa	B	
Wire electric discharge machine	Sample created by electrical discharge machining	Brother Industries HS-300, Underwater cutting	A	
Supercritical water corrosion test equipment	Test in supercritical water loop	TOSHIN KOGYO CO., LTD. Highest pressure:25Mpa, Max temperature:600°C	B	Equipment personnel and the necessary consultation
Superconducting properties evaluation system	Electrical characteristics test under high magnetic field and cryogenic	JASTEC Max magnetic field:15.5T	A	Equipment personnel and the necessary consultation
Spectrophotometer	Measurements of transmittance and reflectance	HITACHI U-3900, Wavelength range:190 - 900nm	B	
Scanning electron microscope (Field emission gun)	Observation of texture and fracture surface, EDX analysis, EBSD analysis	JEOL JSM-6701F	A	
Scanning electron microscope (W gun)	Observation of texture and fracture surface, EDX analysis, EBSD analysis	JEOL JSM-6010	A	
Two-dimensional angular correlation of positron annihilation radiation	Observation of (sub)nano defects and precipitates	Anger camera type	A	Equipment personnel and the necessary consultation
Servo pulsar	Static and dynamic tensile test (Tensile, Three point bending test, Fracture toughness test(K _J test))	Shimadzu Corporation, Capacity:5t, 77 - 100K	B	
Ultra high temperature material testing machine / heat treatment equipment	Static tensile and compression three point bending test in Ultra high temperature region, Vacuum heat treatment	Instron:10t, High frequency heating:2000°C, 2x10 ⁻⁴ Pa	A	
High speed automatic precision polishing machine	High speed polishing of the sample	Refine Tech	C	

Digital microscope	Observation of the sample surface	Keyence Corporation VHX-2000	C	
Iron cell for Alpha and Gamma	Stably maintaining for a long time of the Np compound single crystal growth furnace	Hitachi Zosen Engineering Ltd. Muffle furnace (room temperature - 1100°C), Tubular furnace, Centrifuge	A	Registration nuclide: about 300 species Np, U, Th, Am, Pu
Dilution refrigerator	De Haas-van Alphen effect, electrical resistivity	Maximum magnetic field:15T, Temperature:30mK	A	U, Th compound. JAEA jurisdiction (during the contract ready for serve as a joint-use equipment).
NMR measuring device for low temperature	NMR/NQR Measurement	Max magnetic field:12T, temperature:1.4 - 300K	A	U, Th compound. JAEA jurisdiction (during the contract ready for serve as a joint-use equipment).
NMR measuring device for high temperature	NMR/NQR Measurement	Max magnetic field:6T Temp:normal temp - 600°C, Oxygen partial pressure control with Low temp optiion(3.5 - 600°C)	B	U, Th compound. Equipment personnel and the necessary consultation
Superconducting Quantum Interference Device (SQUID) Magnetometer	Measurements of magnetization and magnetic susceptibility	Max magnetic field:5.5T, temperature:1.8 - 350K	A	U, Th compound. JAEA jurisdiction (during the contract ready for serve as a joint-use equipment).
α-ray spectrometer	Measurements of α-ray spectrum, Quantitative and qualitative anlysis of nuclides	900mm ² Si:3units, 450mm ² Si:3units Measurement range of α-ray:4MeV~8MeV	B	Sealed sample
γ-ray spectrometer (Ge semiconductor detector)	Measurements of γ-ray spectrum, Quantitative and qualitative anlysis of nuclides	ORTEC (SEIKO EG & G) : 1unit, Relative efficiency10%(GMX-10P) , Resolution:1.80keV@1.33MeV, 60Co Measurement range of X-ray and γ-ray : 30keV - 2,000keV	B	Sealed sample

Fluorescent X-ray analysis	Elemental analysis	X-ray Institute of Technology, EDF-05R, Measurement element : Cl - U	B	
Visible ultraviolet and Near infrared absorption spectrometer	Identification of actinide ions, Oxidation state, Determination of brightness	Parking Elmer, lambda750, Wavelength region:190 - 3300nm	B	Th, U, Np, etc.
X-ray diffractometer	X-ray analysis of Powder and Bulk material, Laue photo(Single crystal orientation determination)	Rigaku RINT2500V, Rotating anode(Max=18kw,Cu,Mo) IP film reader	B	
Mossbauer spectrometer	Mossbauer spectroscopy of Fe-57, Au-197, Eu- 151, Np-237, Sn-119m	temperature:3.5 - 300K, Max magnetic field:1.2T	A	U, Th, Np compound
Glove box for neptunium (For electrolysis)	Adjustment of Np amalgam by Aqueous solution electrolysis	Aqueous preparation of NpO ₂ , Electrolytic by Mercury amalgam method Negative pressure management:HEPA filter	A	Np dedicated equipment personnel and the necessary consultation
Glove box for neptunium (For pyrolysis)	Preparation of Np metal by Thermal decomposition, Preparation of Np compounds by Gas reaction method	High temperature electrolysis furnace(- 1300°C), Mantle heater(- 600°C) , Electronic balance	A	Np dedicated equipment personnel and the necessary consultation
Tetra arc furnace	Melting of U compound and single crystal growth	Ultimate vacuum: 7x10 ⁻⁴ Pa sample total weight: 10g or less	B	U, Th compound

Horizontal high temperature tube furnace	Sample synthesis by high temperature sintering method in various atmosphere	OHGITANI Corporation, Ultimate vacuum: -5×10^{-7} Torr, Max operating temperature:1500°C Steady state operating temperature:1400°C, Flange Cooling: water cooled	B	U, Th compound
Vertical high temperature tube furnace	Single crystal growth by Bridgman method and Flux method	Crystal system Ltd. , Ultimate vacuum:- 2×10^{-7} Torr, Max operating temperature:1600°C Gas filling or flow is possible, Flange Cooling: water cooled	B	U, Th compound
Muffle high temperature electric furnace	High temperature synthesis of the sample and heat treatment	Advantech Toyo Ltd. , gas flow function, maximum operating temperature : 1700°C, normal operating temperature: 1600 °C or below	B	U, Th compound
Micro cutter	Cutting of U and Th metals	Refine Tech, Grindstone blade, Diamond blade	C	U, Th, etc.
Inductively coupled plasma mass spectrometer (ICP-MS/MS)	Trace analysis of elements contained in solution samples	Agilent8900	B	The use of nuclear fuel material is not permitted.