Metalllurgical Experimental Center of USTB Equipment Instruction

The Metalllurgical Experimental Center, atteched to School of Metallurgical and Ecological Engineering of University of Science and Technology Beijing (USTB) and Capital Experimental Condition Platform, is a research institution of metallurgical science and technology. With advanced apparatus and abundant approaches, The Experimental center undertook experimental projects from various units inside and outside university. It currently possesses instruments and appraratus of totally worth of RMB 20 million, including 7 equipments costing more than RMB 1 million each and 30 larger-scale other equipments, all of which work at concert pitch. As a vehicular for researching, the experimental center will offer great services for the research of school, university and society.l

More information can be seen in the subsequent table.

No.	Lab	Apparatus	Function	TEl	Location
1.	Phase analysis lab	X-ray photoelectron spectroscopy（XPS） Kratos AXIS Ultra DLD	Surface Analysis: element component、composition、valence state、valence band、crastal structure and depth profiling, etc.	62333797	Room109, Metallurgical Building
		JSM-6701F Field emission scanning electron microscope (FESEM) Thermo NS7Energy Dispertive spectrometer (EDS)	FE-SEM & EDS	62333797	
		JSM-6480LV Scanning electron microscope (SEM) Noran System Six Energy Dispertive spectrometer (EDS)	SEM & EDS	62332337	Room 105-2 Metallurgical Building
		Laitz DMRX Polarization microscope LEICA Q500 Image analyzer	lithofacies/Ore phase/ metallographic phase analysis; Inclusion identifification: Image analysis	62332138	Room105-1 Metallurgical Building
2.	X-ray analysis lab	XRF-1800 X-ray fluorescence spectroscope (XRF)	Element & component analysis	62333597	Room104 Metallurgical Building
		MAC-21 Ultra high power X-Ray Diffractomer (XRD)	Phase & structure analysis	62333597	
3.	Thermo analysis lab	STA409C Thermo Analyzer DSC204Scanning Calorimeter DIL402 Dilatometer	differential thermal analysis; Thermogravimetry; Scanning calorimatry; Thermo expantion analysis	62333474	Room103 Metallurgical Building
4.	Powder property analysis lab	LMS-30 Laser size distribution Determinator	Power grading analysis	62333663	Room102 Metallurgical Building
		MT-1000Powder property Determinator	Powder density, angleofrestrepose,jet flowability and flowability testing	62333663	

5.	instrumental analysis lab	AUTOSORB-1C BET	Specific surface area, porosity testing, etc	82375799	Room 107 Metallurgical Building
		AA-6800 Atomic absorption spectrophotometer	Element analysis（Containing graphitic crucible）	82375799	
		AA-6300 Atomic absorption spectrophotometer（	Element analysis	62332786	Room803 Metallurgical Building
		OPTIMA 7000DV Inductively coupled plasma atomic emission spectroscopy (ICP-OES)	Microelement analysis（Including B）	62332786	Room107, Metallurgical Building
		TCH600 O, N & H analyzer	O, N & H content analysis	62333014	
		EMIA-820V C-S analyzer	C& S content analysis	62333474	
		GCMS_QP2010 Gas chromatography-molecular mass spectrometry detector	Compound qualitative & quantitative analysis	62333014	
6.	Workshop	50kg/10kg Vacuum induction furnace	Metal melting	62332248	Workshop Metallurgical Building
		Electroslag furnace	Electroslag metallurgy	62332394	
		Vacuum carbon tube furnace	Vacuum heating reaction	82375799	
		Iron ore powder sintering and pelletizing machine	Iron ore powder sintering and pelletizing	62332515	

No.	Apparatus	Function	Technical Parameters	Photo

1	**Apparatus：** X-ray photoelectron spectroscopy (XPS) AXIS Ultra ^{DLD}  **Function：** X-ray photoelectron spectroscopy (XPS) - AXIS Ultra DLD , made by Kratos company Japan, is mainly used for surfacial compositon analysis of solid sample; chemical element images; valence band structure; crystal structure analysis and depth profiling。It can be used for inclusion component analysis of metal and alloy; elements depth analysis in slag, minaral phase and materials, etc. it can give specific massage of element changing of every layer(including valence state, content, distribution and element images); applying to non radioactive and non volatilitive metals, alloy semi-conductor, semi-conductor, isolater, powder and sin-film, etc. **Performance index：** - X-ray radial sauce：energy：1-15KV；target（anode）：double anode（standard）；material of target：Mg/Al；maximum power：0.45kw - Electron energy analyzer：Type：180o semi-spherical mirror plus spherical mirror；average radius：165mm - Analyzer electronics ： Fixedanalyzer transmission -FATscanning ， fixed retardant rate -FRR(choosable)、Energy range： 0-3200ev， 0-1500ev （high resolution）； Flux energy：programmable，5-320ev - Analysis room：15 directing analysis point，267mm diameter；magnetic shielding：bilayer μ metal；vacuum degree：7×10-8Pa，2×10-8Pa - Sample control：sample stage：XYZ θ （auto/manual）；sample number：1/10/changable； - Electron sauce（eligible）：energy：10kev；Working Distance：26mm；magnification：×25-150000 - Monochromator：500mmRowland circle；crystal：quartz；maximum power: 0.450kw - Sensitivity：Nonmonochromatic Mg Ka 450W；FWHM=0.8eV Big beam spot：1100000；110μm：200000；55μm 12000；27μm：3000；15μm：500 **Location：** Room 109, Metallurgical Building **Operator：** Feng Ting **Tel：** +86-010-62333797，+86-010-62332525

2

Apparatus :

Field emission scanning electron microscope JSM-6701F
& Energy Disperse Spectroscopy(EDS) NS7

Function:

Compared to SEM, it has higher spatial resolution and stability. It has high secondary electron image resolution ratio, continuous adjustable amplification factor, big depth of focus, combined topogragh observation and composition analysis, and simple sample making. The accessory X-ray EDS can do micro disdinct analysis, with highly sensitive detector, high flux full digital pulse processor, digital image and powerful software function as well.

Mainly used for nonmagnetic substance.

Performance index:

1、FE SEM:

- Distinguishability: 1.0nm (accelerating voltage: 15kV);
  2.2nm (accelerating voltage:1kV)
- Accelerating voltage: 0.5kV ~ 30Kv
- Amplification factor: ×25 ~ ×650,000;
  ×100～650,000(SEM mode), ×25～19,000(LM mode)
- Beam current range: 10-13 ~ 2×10-9A
- Two stage condenser
- Sample chamber: the maximum loading diameter is 150mm.
- Electron gun: full-automatic taper field emission gun

2、EDS:

Elementary analysis range: Be（4） ~U (92)

- Detector crystal area: ≥10mm2
- Distinguishability: > 132 eV, Mn Ka line >5000cps
- Maximum distinguishability of image taken and display is 4096×4096×16bit

Location: Room 109, Metallurgical Building

Operator: Cheng Jin

Tel : +86-010-62333014, +86-010- 62333797, +86-010-62332515

3	**Apparatus**: Scanning electron microscope (SEM) JSM-6480LV &Energy Disperse Spectroscopy(EDS) **Function**: Scanning electron microscope (SEM) and Energy Disperse Spectroscopy(EDX)is a high-end analyzer used for composition and phase analysis,which is a very important tool and widely used in material and metallurgical research. It can be used for material surface analysing, images, secondary electron images and reflected images under high-low voltage, and coarse vacuum as well. **Performance index of SEM**: - Distinguishability of Second electron image : 3.0nm(30kV); 4.0nm(LV) - Amplification factor: ×5～×300000 - Accelerating voltage: 0.5kV～30kV - Beam current: 1pA～1μA - Low vacuum degree: 1～270Pa - Image mode: secondary electron image, backscattered electron image. - Sample size: diameter≤200mm; height≤80mm **Performance index Of EDS** - Distinguishability: 133ev,(Mn Kα, 1000-3000cps) - Elementary analysis: B(5) ~ U(92) **Location**: Room 105—2, Metallurgical Building **Operator**: Wang Lianwei **Tel**: +86-010-62332337, +86-010-62332515

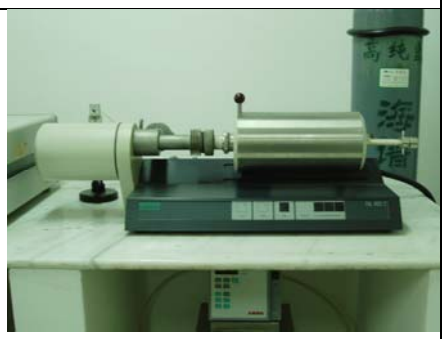
4	**Apparatus:** Polarization microscope image analyzer DMRX  **Function:** Polarization microscope image analyzer DMRX, made by Laitz, Germany, is provided with infinity optical system. Its objective lens is unstressed and unaberrational, and has wide field of vision, high sharpness and advanced lighting system, which ensure the image contrast and light uniformity. The equipment is also equiped with large size stable vortical objective table Image analyzer Q500, offered by LEICADC100IW, Cambridge of England, is provided with digital camera lens DC100. It is a trur colour camera, with RGB mode and colour depth 24BIT, is able to seperate 16.7 million colours. Thus it is appropriate forimage manipulation. It can do real-time image taking, 24 pictures per second; and has image analysis software, including interactive testing and automatic testing, which is suitble to test the gray level, size, acreage, perimeter, acreage percentage and grain quantity. Tha software package contains QUIPS macro software language and is able to record the image manipulation and operational program. Software programs can be edited as needed to improve quantitative measurement rate. Large-scale polarization microscope DMRX plus image analyzer Q500 can do qualitative and quantitative photographing and micro observation analysis to the materials such as:ferrous materials, fireproofing, coke, coal,etc. Large-scale polarization microscope DMRX plus hot stage can warm and cool materials such as:ferrous materials, fireproofing, coke, coal,etc; and qualitative and quantitative photographing and micro observation analysis to the phase transformation and crystal transfer at different tempratures. The maximum temperature is 1750℃. **Location:** Room 105—1, Metallurgical Building **Operator:** Liang Delan **Tel:** +86-010-62332138, +86-010-62332515

5	**Apparatus:** Steel phase analysis system Including: 1) Leica metallurgical macroscope DM6000M 2)Inclusion component calculating software Thermo-Calc **Function:** DM6000M, made in 2004 by Leica, German, is a full-automatic intelligent material microscope.The intensity of light source, aperture diaphragm and relative parameters can be ajusted to ideal condition as objective lens and observation method change, thereby clarify the images. Its function contains: light and dark field, polarized light, transmission (Biological samples) and automatic differentiation interferenc…etc. It can also mark the sample as needed. The distinguishability of camera is 3,000,000 pixel and amplification factor is 50-1000.It is mainly used in the observation and image analysis of inclusions and structure of metallographical sample. Software SISC IAS8 can collect real-time images clearly, and make various quantitative analysis for them, such as quantity statistics of metallurgical phases, automatic statistics and evaluation of inclusion, grain fineness number analysis, macrohardness measurement and multi-phase area percentage analysis…ect. Thermodynamics calculating sofetware is TCCR, the classic version of Thermal-Calc.Developped by The Royal Institute of Technology (KTH), it can calculate the equilibrium of complex Heterogeneous phase, multicomponent phase diagram, and Thermodynamics factor…etc. **Location:** Room 1101, Metallurgical building **Operator:** Wang Wanjun **Tel:** +86-010-62332522/62332515
6	**Apparatus:** Leica metallurgical macroscope DM4000M **Function:** DM4000M, made in 2004 by Leica, German, is a full-automatic intelligent material microscope.The intensity of light source, aperture diaphragm and relative parameters can be ajusted to ideal condition as objective lens and observation method change, thereby clarify the images. Its function contains: light and dark field, polarized light, transmission (Biological samples) and automatic differentiation interferenc…etc. It can also mark the sample as needed. The distinguishability of camera is 3,000,000 pixel and amplification factor is 50-1000.It is mainly used in the observation and image analysis of inclusions and structure of metallographical sample. Software SISC IAS8 can collect real-time images clearly, and make various quantitative analysis for them, such as quantity statistics of metallurgical phases, automatic statistics and evaluation of inclusion, grain fineness number analysis, macrohardness measurement and multi-phase area percentage analysis…ect. **Location:** Room 906, Metallurgical building **Operator:** Cheng Yu **Tel:** +86-010-62332534

7	**Apparatus:** X-ray fluorescence spectroscope XRF-1800  **Function:** This euipment is mainly used in the research area of electric, maganic materials, chemical industry, petroleum, coal, ceramics, cement, steel-making, non-ferrous metal, geology and mineral products, Analysis range of elements: F(9) - U(92) **Performance index:** - X-ray tube: 4Kwthin window Rh target window type. - Maximum power : 60KV 140mA - Output stability : ±0.005% output voltage fluctuation +15%--10% - Sample room: 8 sample turn table, Sample rotating: 60rpm X-ray irradiating - Scanning speed: superspeed scanning:300°/min quantitive and qualitive analysis; 250um micro distribution analysis **Location:** Room 104, Metallurgical building **Operator:** Zhang Ying; **Tel:** +86-010-62333597, +86-010-62332515
8	**Apparatus:** X-Ray Diffractomer (XRD)  **Function:** Super power X-Ray Diffractomer M21X, made by MAC Seience Co.Ltd Japan, is mainly used in phase identification;matter structure;hot metal; refractory matter property testing and metallurgical process mechanism testing.The working atmosphere is air or argon gas.It appoint with computer contral system, data acquisition and analysis software and data base PDF2, etc. **Performance index:** - The maximum power of X-ray diffraction radio-frequency generator is 21kw, rated tube voltage is 20—60kv; maximum rated current is 500mA; - Two Vertical wide angle goniometers, radius of angle goniometers is 185㎜, 2θ angle measurement range is 0o～120o, right side is used for room temperature sample, left side is used for high temperature accessory; - Automatic rotating anode (SRA), oscillation is less than 0.2μm, automatic adjustable aperture unit, stability is less than 0.005%; - High temperature accessory (The maximum temperature is 1200℃), working in air/argon atmosphere, vadose water cooling system **Location:** Room 104, Metallurgical Building **Operator: Zhang Ying**

	Tel：+86-010-62333597，+86-010-62332515
9(1)	Apparatus： Multiple thermoanalyzer STA409 Function： Multiple thermoanalyzer STA409, made by NETZSCH, Germany, is composed of the rmogravimetric analyzer, differential thermal analyzer , calorimetric analyzer and mass spectrum analyzer. With ultra-temperature measurment and middle-to-high temperature thermal analysis mass spectrometer, on-line off-gas can be analysed, which is at the advanced level of the world. And accessory equipments like differential scanning adiabatic calorimeter DSC204 and thermal dilatometer DIL402 work as auxiliary  **Research area.** Research feild: themal stability; component analysis; melting point testing; decomposition temperature; reduction temperature ; decomposition dynamics; material inoxidizability; material synthetic technology. Used with QMS at 1400°C can analyse resolved Cemergent gas. **Performance index：** - Temp range: 25°C～1400°C、25°C～2000°C - Sample weight: 0～20 g - Weighting scope 0～50 g - Heating rate 0.1～50K/min Environmenal atmosphere of the sample can be chosen 25°C～1400°C in the air , or 25°C～2000°C in Argon gas.

	Location：Room 103, Metallurgical building **Operator**： Zhang Mei **Tel**：+86-010-62333474，+86-010-62333014，+86-010-62332515
9（2）	**Apparatus**： Thermal expansion analyzer DIL402 **Research feild**： Coefficient of thermal expansion; phase transform; Glass Transition Temperature,; sintering rate control; Influence of annexing agent; dynamics research of sintering.; **Performance index**： - Tempreture range:25 °C～1500°C; Heating rate: 0.1～10K/min - Sample size Φ12 ㎜(max)×25 ㎜(max) - Working atmosphere: inert/ oxidation/reducing atmosphere; **Apparatus**： Differential scanning adiabatic calorimeter DSC204 **Function**： Melting point; glass transition temperature;phase transform tempreture; melting heat;heat of crystallization; purity; specific heat; oxidization induction period; crystallinity。 **Performance index**：

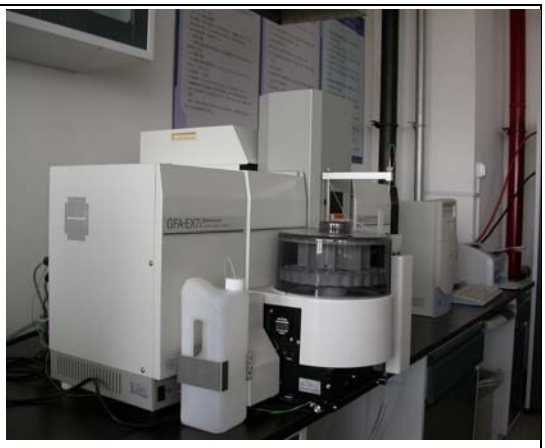
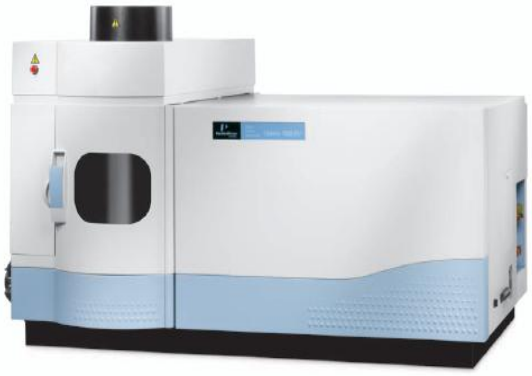


	➢ Tempreture range: -170～700°C ➢ Heating rate: 0.1～50K/min **Location**：Room 103, Metallurgical building **Operator**：Zhang Mei **Tel**：+86-010-62333474，+86-010-62332515
10	**Apparatus**：Laser Particle Sizer LMS-30  **Function**： Laser Particle Sizer LMS-30, made by Japan fresh Co., LTD, is mainly used for performance measurement of powder with size of 0.1—1000μm (metal powder, nonmetal mining powder, coal powder…etc), for the grain size, size distribution, specific surface area and processing disperse. The testing costs little time and the result is calculated by computer, obtaining the data steadily and accurately. It can be used in many field such as the injection powder of furnace, sinter pellet powder, environmental protection, powder metallurgy, food making, medicine making and chemical industy…etc. **Performance index**： Principle: Laser diffracting、scattering. Measure scale：0.1～1000μm Optical source：Semi-conductor (Wavelenth 670nm） Size：Noumenon: 650（W）×315（D）×400（H）mm Loop body: 200（W）×450（D）×400（H）mm Weight：Noumenon :40kg；loop body :20kg Power source：AC100V 5A **Location**：Room 102, metallurgical building **Operator**：Song Zhongping

	Tel：+86-010-62333663，+86-010-62332515
11	Apparatus：Powder property multifunction MT-1000  Function： Powder property multifunction MT-1000,made by Japan Fresh Co., LTD,is mainly used for property analysis of powder evaluation, grain design, breaking system and powder transmission system. The resolution and characteristic of measured value took use of Chili Sauce index and Carr index, in cornside with theJIS testing method of apparent density, can be used widely. **Performance index：** 1、 13 kinds of property of powder can be analysized as follows: 1) Apparent density 2）Tap densit y(Centain volume method) 3）Tap density y(Centain weight method) 4）Depositional gradient angle 5） Board spoon angle 6）Collapse angle 7）Dispersion degree 8）Agglutination degree 9）－13）5 Kinds of tap densitiy (JIS method) 2、 Flowability and adhesive force. can be calculated; 3、 Tap density,meassured by Centain volume method in powder industry can be resoluted by Chili Sauce vibrate- condense formula and obtain final tap density, flowability, adhesive force, primary and final voidage. Container of 50cc、25cc and 20cc size can be chosen, and the containers for a small amount of specime as well. 4、 Can calculate Carr flowability index and floodability index, which are property indexes of powder materials. Carr index can be calculated by 7 measured values and 3 affiliated values, which can be obtained by the equipment.

	Location: Room 102, Metallurgical building **Operator:** Song Zhongping **Tel:** +86-010-62333663, +86-010-62332515

12	**Apparatus:** Physisorption and Chemisorption Analyzer AUTOSORB-1C **Function:** Physisorption and Chemisorption Analyzer AUTOSORB-1C, made by Quantachrome Instruments company, America, is The most sophisticate powder specific surface area and porosity analyzer of thw world at present. - Dynamic state temperature programming (Flow TPR/TPD) - Static pressure state temperature programming (Soak TPD) - Vacuum state temperature programming (Vacuum TPD) - Chemisorption isothermal curve - Monolayer cover quantity - Active (metal) dispersion degree (percentage) (particular function) - Average microcrystallite dimension - Adsorption heat - Physical adsorption isothermal curve and distribution of micropore and Mesoporous. **Performance index:** - 1 analysis statiopn and 2 preparation station - 5 path air inflow - High temperature furnace (1100℃) - Patent oil-free vacuum system - 5 high-precision sensor and 1 liquid level sensor, vacuum degree is 10-10mbar(analysis station and degassing station) - Superficial area range: 0.0005 - 5000 m2/g - Pore volume: <0.0001 cc/g - Bore diameter: 3.5 - 500A (0.35 - 500 nm) **Location:** Room 109, Metallurgical Building **Operator:** Sun Gensheng **Tel:** +86-010-82375799, +86-010- 62332515

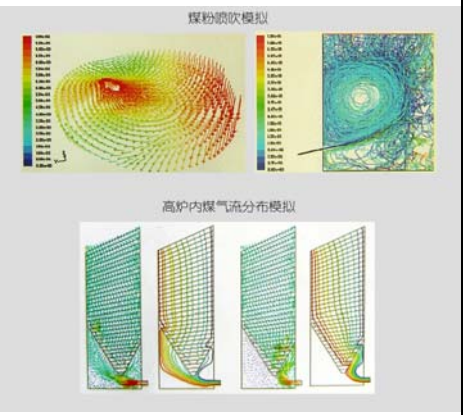
13	**Apparatus:** Atomic absorption spectrophotometer AA—6300, AA-6800  **Function:** The equipment is provided with air-acetylene flame and graphite furnace, and can detect about 30 elements in soil, plant, steel and non-ferrous materials. The floor level of air-acetylene flame testing method is 1mg/L, and of graphite furnace tseting is 1μg/L。 Special element detecting method is determined by its value. **Location:** Room 803, metallurgical building (AA-6300) ; 107 (AA-6800) **Operator n:** Wang Lihua(AA-6300) Tel: +86-010-62332786, +86-010-62332515 **Operator:** Sun Gensheng(AA-6800) Tel: +86-010-82375799, +86-010-62332515
14	**Apparatus:** Inductively coupled plasma atomic emission spectroscopy (ICP-OES). OPTIMA 7000DV  **Function:** Inductively coupled plasma atomic emission spectroscopy (ICP-OES, made by Perkinelmer,co…ltd America, is mainly used for semi-quantifive or quantifive analysis of impurity elements (main scale, microscale or trace scale). Based on solid detector, it is the full spectrum of direct reading plasma emission spectrometer, consists of radio-frequency generator, plasma , sample injection system, beam splitting system, detector, analysis software and computer system. **Performance index:** - Analysing rate: ≥10elements/min, real time background correction; - Dynamic range: ≥106 wavelength range: 160～900nm or all the wavelength including the above one; - Background correction: contemporary background correction, background correction point is taken automaticly or manualy; - Distinguishability: ≤0.003nm (at 200nm) - Stability: 1hour stability: RSD≤1.0%,4hour stability RSD＜2.0%; - Frequency: 40.68MHZ; - Power: 750W～1500W or more, 1W continous adjustable increment; Power stability: ≥ 0.1%; - Optical path system: driving gas type, high-performance middle ladder grating two-dimensional

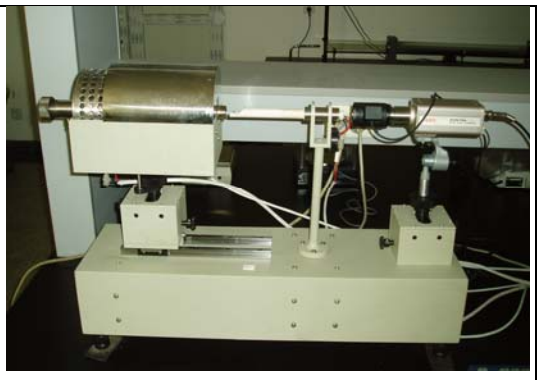
	dispersion spectrometer system； **Location**：Room 107, Metallurgical Building **Operator**：Wang Lihua **Tel**：+86-010-62332786，+86-010-62332525
15	**Apparatus**：O-N-H analyzer TCH600 **Function**： Microscale analysis of O、N、H inside solid sample (steel and inorganic substance) Standard sample weight: 1g， Analysis scale： O:0.05ppm～5%； N：0.05ppm～3%； H：0.1ppm～0.25% Degree of accurancy： H：0.005ppm或2%RSD； N：0.025ppm或0.5%RSD； O：0.025ppm或0.5%RSD； Analysis method： O,H：non-scattering infrared absorption method； N：thermal conductance method **Location**：Room 107, metallurgical building **Operator**：Han Lihui **Tel**：+86-010-62333014 

16	**Apparatus：** C-S analyzer EMIA-820V  **Function：** Microscale analysis of C and S inside solid sample (steel, slag and inorganic substance) Analysis range： C：~1ppm～6.0%； S：~ 1ppm～0.4%； Analysis precision： C：0.3ppm 或 0.5%RSD； S：0.3ppm 或 0.5%RSD； **Location：** Room 107, Metallurgical Building **Operator：** Zhang Mei **Tel：** +86-010-62333474
17	**Apparatus：** Gas chromatography molecular mass spectrometry detector -GCMS_QP2010  **Function：** It is used for the quantitive and qualitive analysis of solid and liquid phase of metallurgical production, on-line and off-line. Property of equipment at the level of national standard. **Performance index：** - New designed high-brightness ion gun，provided with low noise testing system，has improved S/N ratio and chieved ultrahigh sensitivity. Strong （QA/QC）function and GLP surporting function. Mass scale: 1.5～1090 m/z； - Resolution ratio R≥2M(FWHM)； - Maximum scanning speed 10000amu/s； - Sensitivity: Scan 1pg S/N≥185 E1，standard sample OFN、SIM 100fg S/N≥185 m/z=272； - Double enter pot turbomolecular pump differential motion system，Vacuum di speed >360L/S。 **Location：** Room 107, metallurgical building **Operator：Feng Gensheng; Yu Chunmei** **Tel：** +86-010-62333014

18	**Apparatus：** Infrared spectrometer & infrared microscope  **Function：** Infrared spectrometer & infrared microscope, made by Nicolet corporation, america, is mainly used to analysis molecular structure of functional group. The infrared spectrum wavelenth range of FTIR is 350—7000cm^{-1} , which can be used in infrared spectrometry of spot, line and area analysis for sample surface. Infrared microscope is mainly usded for analysing the microcell functional group and structure at μ level. It is provided with funtions of automatic/manual operation, locating and focusing,etc, which can be used for the interchange of absorbance and transmittance. **Location** Room 109, Metallurgical Building **Operator：** Zhang Yingfang **Tel：** +86-010-82375842
19	**Apparatus:** Water modeling system  **Function：** （1）Converter splash protection, flow behaviour of molten steel in Converter; （2）Flowability and miscibility of molten steel inside LFfinery、AOD furnace、VOD furnace、CAS, etc; （3）Argon blast of steel ladle、tundish metallurgy、flow behaviourof molton steel incrystallizer; （4）Measurement of secondary cooling analog controlsystem;  **Devices：** （1）Circulating water system: storage water tank, pipeline, flowmeter and flow control valves, etc. （2）Gas system: gasholder, gas pipeline, flowmeter, valves, etc. （3）Model: converter, LF finery, steel ladle, tundish, crystallizer, etc. （4）Measure and control instrument: conductivity meter, Siemens programmable logic controller (PLC) (metallurugical process automatic control simulation programm), Wave Height Gauge , computer, Slice illuminant, digital camera, etc. **Location：** Room 107(underground), Metallurgical Building **Operator：** Han Lihui **Tel：** +86-010-62333014，+86-010-62332515

20	**Apparatus**：Analog system **System constitution**： 1）Calculating software CFD：Fluent 6.3.26 CFX 11.0 2）Meshing software：ICEM CFD 11.0 Gambit 3.2.30 3）Hpworkstation and 及 high allocated computer.； **Software instruction**： CFX, developped by AEA compony, England, and purchased by Ansys compony, America, is a practical analysis tool for journal of fluids engineering. It is used for simulating the flow fluxion, heat transfer, multiphase flow, chemical reaction and combustion.It specializes in conducting the problems with sample flow physical phenomenonand complex geometry shape. The scope of application is: system of rectangular coordinates/cylindrical coordinate/rotated coordinate; Instant /Sliding Mesh; incompressible/slightly compressible/compressible flow; Buoyancy-driven flows; multiphase flow; non-Newtonian fluid; chemical reaction; combustion; Nox generation; radiation; porous media and multi heat transfer process. FLUENT is one of the advanced CFD software in the world. It is widely used for simulating the fluid flow, heat transfer, combustion , pollutant migration and fuel cell, ect. The main function includes: importing grid model, providing physical model of calculation, inflicting bondary condition and property of material, solution and subsequent management. Grid forming softwares surpprted by FLUENT include GAMBIT, Tgrid, prePDF, GeoMESH and other CAD/CAE package. **Location**：Room 107, Metallurgical Building **Operator**：Han Lihui **Tel**：+86-010-62332515，+86-010-62334991



21	**Apparatus：** Slag melting point and speed locator RTW-10 **Function：** The melt materials property multifunction RTW-10 is mainly used for the analysis of viscosity, surface tension and density of high-teprature melt. The torque sensor is adopted to improve analysis precision and the data was collected and managed by computer automaticly.  **Performance index：** - Silicon carbide heating furnace; Maximum working temprature 1450℃. - Temprature control unit, PID computer program control - Thermocouple：S type Single platinum rhodium. - Temperature transmitter：Double wiring system、linearization、temprature autocompensation **Location：** Room 108, Metallurgical Building **Operator：** Du Chunrong **Tel：** +86-010-82375169，+86-010-62332515

22

Apparatus：Melt materials property multifunction RTW-10

Function：

The melt materials property multifunction RTW-10 is mainly used for the analysis of viscosity, surface tension and density of high-teprature melt. The torque sensor is adopted to improve analysis precision and the data was collected and managed by computer automaticly.

Performance index：

- Silicon carbide heating furnace;
  Maximum working temprature 1450℃.
- Temprature control unit, PID computer program control
- Thermocouple：S type Single platinum rhodium.
- Temperature transmitter：Double wiring system、linearization、temprature autocompensation

Location：Room 108, Metallurgical Building

Operator：Du Chunrong

Tel：+86-010-82375169，+86-010-62332515

23	**Apparatus:** Iron ore performance analyzer  **Project:** 1) Reducibility measurement of iron ore at 900℃, according to ISO7215 standard.And the technological parameter in accordance with GB/T13241—91standard。 2) Reduction degradation measurement of iron ore at low teprature, according to ISO7215 standard , and technological parameter in accordance with GB/T13241—91standard. 3) Reductive inflation index of pellet measurement, according to ISO/DP4698 standard , and technological parameter in accordance with GB/T13241—91standard. **Device:** - Reduction furnace ISO7215 - Standard reduction reaction tube ISO7215（GH44）、 - ES—20KA/0.1gelectronic balance - CO high temperature reforming furnace（1200℃）、 - KTNJ10KW silicon controlled voltage regulator; ISO Low temperature pulverization drum device. - Expansion index of Pellet reduction assay container（GH44 material）、 - Computer data-processing system **Location:** Room 108, Metallurgical Building **Operator:** Feng Gensheng **Tel:** +86-010-62334991, +86-010-62332515
24	**Apparatus:** Coal powder property testing multifunction  **Function:** Coal powder property testing multifunction CPBITI-II, developped by University of Science and Technology (USTB), is mainly used for testing the length of flame and fire point of exploded coal powder. It is widely used in teaching, reseraching and producting process. The equipment consists of industrial control computer, temprature controller and reletive electric accessory, automating the process of warming; coal powder injection; ignition; residue clean and testing, recording and printing of flame length. It is a automatic analyzer of simple structure, stable performance and convenient operation. **Performance index:** 1、 Range of flame length: 0-800mm

	2、 Gauge length resolution ratio: 10mm 3、 Coal powder injection rate: 1g 4、 Temprature control area: 0-1600℃ Working temprature: 1100℃ Control accuracy: 1% 5、 Fire point measurement: Warming method: PWM, open cycle,warming upper limit: 600℃ Temperature resolution: +/- 1℃ Contour dimension: 2000x500x800mm+600x500x1300mm 6、 Weight: about 500Kg 7、 Power dissipation: <3000W; power source: 220V single phase, 50Hz/60Hz 8、 Working environment: 0-50℃, relative humidity <85%(non-moisture condensation), vibrationless, non-corrosiveness gas. **Location**: Room 108, Metallurgical Building **Operator**: Song Zhongping **Tel**: +86-010-62333663, +86-010-62332515, +86-010-62334991
25	**Apparatus & Performance index**:   1. Ultra-temperature tube furnace SKZ18—BLL Maximum temperature: 1800℃ Hearth size(mm): Ø 70*100 Equal temprature lenth: ≤100mm Atmosphere: oxidation/neutral/reduction atmosphere Heating material: LaCr03 2. Ultra-temperature tube/crucible dual-purpose furnace SGDZ16—BLL Maximum temperature: 1650℃ Hearth size of tube furnace (mm): Ø 80*100 Heating material: MoSi2 Hearth size of crucible (mm): Ø 250*300 Equal temprature lenth: ≤100mm Atmosphere: oxidation/neutral/reduction atmosphere 3. High temprature chamber oven SX13—BLL Maximum temperature: 1350℃ Hearth size (mm): 150*100*120 Heating material: SiC Hearth size (mm): 300*500*200 Equal temprature lenth: ≤100mm Atmosphere: oxidation/neutral/reduction atmosphere 4. High-temperature tube furnace SKZ13—BLL Maximum temperature: 1350℃～1600℃, Hearth size(mm): Ø 30*200 Equal temprature lenth: ≤100mm Atmosphere: oxidation/neutral/reduction atmosphere Heating material: SiC $MoSi_2$ Electrothermal blowing dry box CS101—2EB

	Temprature range: 25℃—300℃ Chamber siza(mm): 500*550*500 Argon arc welding machine and thermoelectric couple calibrating **Location:** Room 108(underground), Metallurgical Building **Operator:** Zhang Ying **Tel:** +86-010-62333597, +86-010-62332515
26	**Apparatus:** 10kg Vacuum induction furnace  **Function:** 10kg vacuum induction furnace and mating external electric field processing unit is mainly used on research of new metallurgical materail, new process experiment, preparation of new materials, dephosphorization and desulfuration of metallurgical process, etc. **Performance index:** - Rated capacity: 10kg (steel) - Normal rated: 60kW - Final vacuum: 6.6×10-3Pa - Working vacuum degree: 6.6×10-2Pa - Vacuum system configuration: - KT-300 oil diffusion pump＋2X-30mechanical pump - Multistationgating system - Electrode promotion and demotion system - Cooling water、gas connector。 - Raming system. **Location:** Work shop, Metallurgical Building **Operator:** Wang Yugang **Tel:** +86-010-62332248, +86-010-62332515

27

Apparatus: Electroslag furnace

Function:

Refined metal after electroslag process can reduce the content of nonmetal inclusion and its distribution and kenel. It also use the crystallographic strong water cooling to improve the crystal structure and intensity of material.

Performance index:

- Transformer capacity 400KVA
- Working voltage: 30-49V
- Working current: 3000A
- Maximum capacity of crystallizer: 60Kg

Location: Work shop, Metallurgical Building
Operator: Cheng Boping
Tel: +86-010-62332394, +86-010-62332515

28

Apparatus: Vacuum carbon tube furnace

Function:

The equipment consists of furnace body, bottom gearing, top vacuum semicontinuous charging system, vacuum machine set, water cooling system, transformer and electric control cabinet, etc. The multifunction vacuum carbon tube can be used at vacuum or antivacuum condition, and is used for metallurgy, physical chemistry, high-temprature metallurgy, high pure metal refiness, slag action and inorganic nonmetal material sinnering experiment, etc.. It is the most advanced carbon tube furnace of China.

Performance index:

- Maximum working temprature: 2300℃, common use temprature: 1600℃—1900℃, temperature programming;
- Silicon controlled pressure regulating, end vacuum: 1×10^{-3}Pa, heating power: 72KW;
- Heater size Φ156/140×370mm, vacuum charging;
- Bottom discharge and rotated crucible device., with rotational speed 20—200r/min, stepless speed regulating;

Location: Work shop, Metallurgical Building
Operator: Sun Gensheng
Tel: +86-010-82375799, +86-010-62332515

29	**Apparatus:** Multifunctional vacuum induction furnace **function:** Multifunction vacuum induction furnace, made in England, is used for high temprature heat research, vacumm metallurgy and external refining. The nominal capacit y is 25Kg. It can make and research on high-quality metal with electroslag furnace 400KVA. **Performance index:** - Vacuum melting and antivacuum melting - Vacuum sampling, charging and ingot casting - Vacuum degree is 2×10^{-2}torr **Location:** Work shop, Metallurgical Building **Operator:** Chen Boping **Tel:** +86-010-62332394, +86-010-62332515 
30	**Apparatus:** Iron ore powder sintering and pelletizing device **Function:** The System is provided with Φ200 Sinter pot with the 500-700 ㎜ height layer, and can work under different subatmospheric pressure, with different bad height of materials. It is provided with efficient lighting system. According to the high burning temprature and large temprature scale, it can be used for different firing temprature, firing intensity and hot gas sintering, etc It has efficient blender mixer cask with adjustable rotate speed, filling ratio, and time, which can be used for simulating the mixing and pelletizing process of sinnering experiment. **Location:** Work shop, Metallurgical Building **Responsible person:** Feng Gensheng **Tel:** 62334991, 62332515