

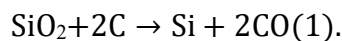
*Jiyanova Sayyora Ibragimovna**Doctoral student of Termiz State University**Turaev Khayit Khudaynazarovich**Professor of Termiz State University**Eshmurodov Khurshid Esanberdiyevich**Tashkent Research Institute of Chemical Technology**Email: [jiyanovasayyora2021@gmail.com](mailto:jiyanovasayyora2021@gmail.com)***SEPARATION OF CRYSTAL SILICON THROUGH METALLOTHERMAL REDUCTION**

**Abstract:** In this scientific research, research was carried out on the extraction of crystalline silicon by enriching and returning the sand of the "Jerdanak" quartz mine in Sherabad district of Surkhandarya region. Quartz sand without enrichment was analyzed by X-ray phase method, and the amount of silicon (IV) oxide (SiO<sub>2</sub>) and additional substances was determined. This work presents the results of experiments on technical silicon extraction processes by enriching sand and then reducing it with aluminum and magnesium. The obtained samples were reanalyzed.

**Key words:** electricity, energy, quartz, quartzite, temperature, mineral, silicon, reducing, aluminum, magnesium, carbon, electric furnace.

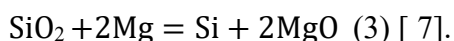
Electricity in our daily life to energy was Demand year as increased is going Electric of energy main sources - oil, gas, coal, uranium and their reserves decreased to go is being observed. The last one in years scientists greenhouse gases of the amount increase surroundings environment, ecology negative effect that it is a lot about thought they say. That's why for, re recoverable energy using sources (QTEM), ecological clean electricity energy work to get out attention increased. Most efficient again recoverable energy from sources one the sun panels - solar radiation directly electricity to energy rotate will receive devices [ 1,2]. More than 90% of solar cells on the market today are silicon-based [ 3].

TS (technical silicon) used in industry is obtained by processing quartz sand. The most common modern method of obtaining TS is the reduction of silicon dioxide with coke in electric furnaces. The mixture of sand and coke enters the crater of the furnace, where it is heated to 1800-2000°C by an electric arc created between carbon electrodes. At such temperatures, the carbons of the coke and electrodes interact with silicon oxide, turning into carbon monoxide gas and returning the sand to TS [4]:



Traditional solar cells are made from inorganic semiconductors - poly and monocrystalline silicon, gallium arsenide, etc. Such solar cells have high efficiency and long service life, but the production is very expensive [5]. In our research work, the technology of extracting technical silicon from local quartz sands and electronic grade silicon was studied. Most of TS is used in the metallurgical industry as a component of alloys, for example, in the smelting of bronze, iron and steel, as well as as an alloying element or modifier of metal properties [6].

Taking TS in the laboratory returners as magnesium and from aluminum use can:



$\text{SiO}_2$  scientists from Annaba University of Algeria stated that magnesiothermic reduction is a widely used method in the laboratory due to its simplicity, low temperature, and low production cost. However, the inevitable formation of magnesium silicide ( $\text{Mg}_2\text{Si}$ ) during the reaction reduces the use of this method. In their work, they worked on obtaining high-purity silicon by pretreatment of quartz sands by acid washing [8,9]. Scientists from Rajshahi University in Bangladesh have studied the technology of obtaining silicon ( $\text{Si}$ ) from Padma river sand by aluminothermic reduction  $\text{Si}$ . The  $\text{SiO}_2$  content before and after beneficiation of the sand was found to be around 88% and 95% when examined by XRF (X-ray fluorescence). In the aluminothermic process, aluminum ( $\text{Al}$ ) was used to reduce  $\text{SiO}_2$  (sand) and produce  $\text{Si}$ .



(4) the reaction was carried out at a temperature of 1200-1300°C. Then, the sample formed as a result of the reaction was further purified by acid washing. Optical microscopy and SEM (scanning electron microscopy) were used to determine the average sand particle size and surface morphology before and after enrichment, respectively [10,11].

The purpose of the study

Technical silicon extraction by beneficiation, purification and metallothermic reduction of quartz sand.

Research tools and methodology

Quartz sand - occurs in nature in various purity. Sand contains other components such as aluminum, sodium, calcium and potassium (feldspar minerals). The chemical formula is  $\text{SiO}_2$ . Quartz has piezoelectric properties. Hardness 7. Density 2.65 g/cm<sup>3</sup>. Liquefaction temperature 1710°C, when cooled quartz the so-called window to the body becomes single crystals less occurs and very high is evaluated [12].

Aluminum ( $\text{Al}$ ) - silver of the 13th group of the periodic system white metal is considered  $\text{Al}$  is the most abundant metallic element in the earth's crust, but it is never found in its elemental state in nature. It is mainly in the form of very stable oxides: hydroxides and silicates. Aluminum has many useful properties. It is flexible and light. Pure aluminum is relatively soft and weak, but forms many strong alloys. It has high thermal and electrical conductivity. The aluminum oxide film attached to the surface makes it corrosion resistant. Most acids are resistant, but alkaline solutions dissolve the oxide film and cause rapid corrosion [13].

Magnesium (Magnesium),  $\text{Mg}$  - Mendeleev's periodic table to the II group of the system belongs to chemical element; alkaline earth to metals enters Order number 12, atomic mass 24,305. Magnesium in 1829 French chemist Magnesium Bussy magnesium to chloride potassium steam influence Magnesium metal in case separate received Magnesium mass in terms of land 2.35% of the post organize does 100 of magnesium more than minerals there is. Magnesium light silver colorful metal as manifestation will be subtle material is water with to the reaction entering, hydrogen, flammable the gas, but this reaction sodium or of lithium water with reaction such as strong it's not. Delicate when dispersed, it is very fast ignites strong white fire with burns [14]. Ours research  $\text{Al}$  and  $\text{Mg}$  in our work returning as used.

X-ray diffraction (XRD) is an analytical method that provides information on crystal structures, phases, crystal orientations (texture), and other structural parameters, such as average

size, crystallinity, deformation, and crystal defects. X-ray diffraction peaks are formed by constructive interference of monochromatic X-rays scattered at certain angles from each lattice plane in the sample. The highest intensity is determined by the distribution of atoms in the lattice [15]. In our work, a powder diffractometer manufactured in Japan "SHIMADZU" XRD-6100 was used.

A scanning electron microscope (SEM) is a device used in many industrial laboratories to analyze research results. Due to its large focal depth and X-ray microanalysis capabilities, SEM is often used in materials science, including polymers, to elucidate the microscopic structure or distinguish between multiple phases [16]. In this research work Microstructure analysis was performed with Jeol JSM-IT200LA (Japan) SEM - EDS energy dispersive analysis application.

Enrichment - when any natural raw material is mined, it contains a certain amount of additional impurities in addition to useful minerals. Enrichment is the increase of beneficial components in the mineral content. Different methods of enrichment of raw materials are used depending on their aggregate state. Grinding jaw grinder, conical feeling machines, shaft chopper, hammered grinder, spherical in crushers (mills). done is increased. Mechanical enrichment methods include sorting, gravity separation, electromagnetic, electrostatic separation, flotation methods [17,18,19].

#### Experimental part

XRD and SEM analyzes were carried out before enrichment of quartz sand brought from the "Jerdanak" quartz mine of Sherabad district. The analyzed sand sample is 0.63 sieve (D120/H38 steel wire).

Because of C to beat the sand gravel and clay can distinguish [ 20]. Announced in a nanomill where the sand rotates 400 times per minute (Retsch PM 400 ballmill) 200-300 milled to nm. Crushed quartz 18 g of sand, technical taking 10.8 g of aluminum mixed (based on reaction 4). Primary substances  $\frac{\text{SiO}_2}{\text{Al}} = \frac{3}{4}$  mol in proportion received \_ Same also according to the 3rd reaction , crushed quartz 12 g of sand , 9.6 g of magnesium (  $\frac{\text{SiO}_2}{\text{Mg}} = \frac{1}{2}$  mol ratio ) was mixed . Ready mixtures at a temperature of 1300°C for 6 hours during in the reactor returned. Received products distilled in water 4 times after washing \_ acids using processing given \_ Filter paper (diameter 15 cm FB - III using GOST 12026-76). from filtered then at a temperature of 100°C muffle in the oven dried. Received of samples physical and chemical properties, element composition determination in order to XRD, SEM were analyzed.

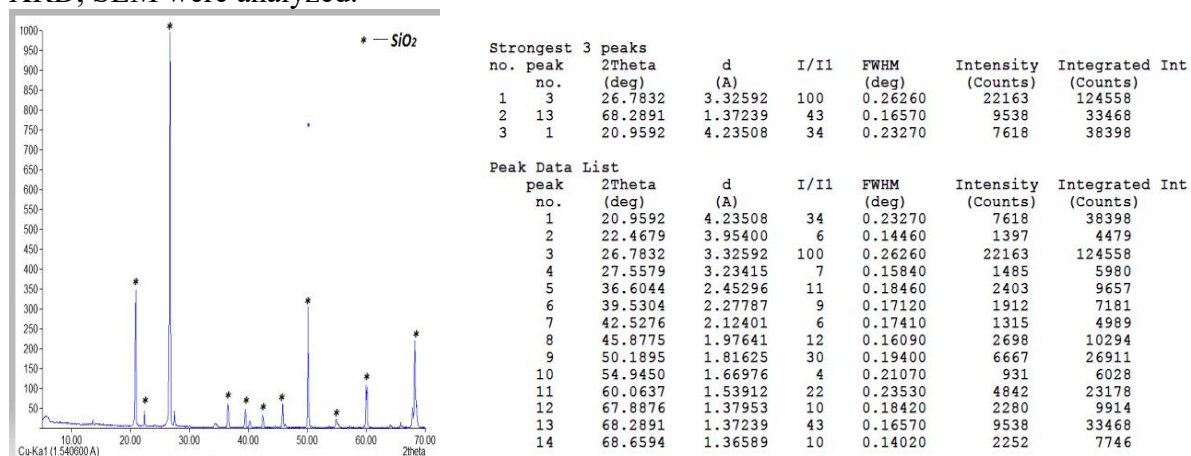


Figure 1. XRD analysis graph of natural quartz sand

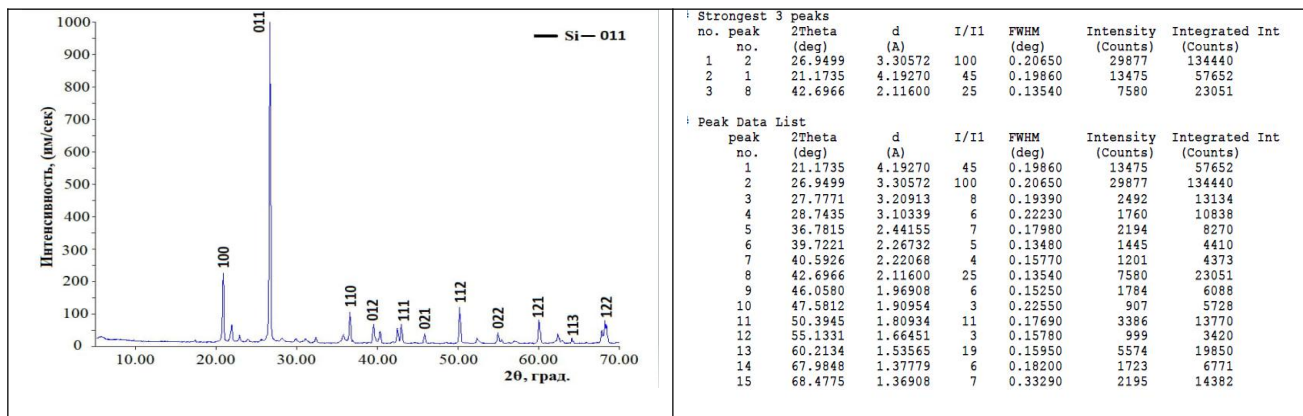


Figure 2. XRD analysis graph of quartz sand treated with magnesium

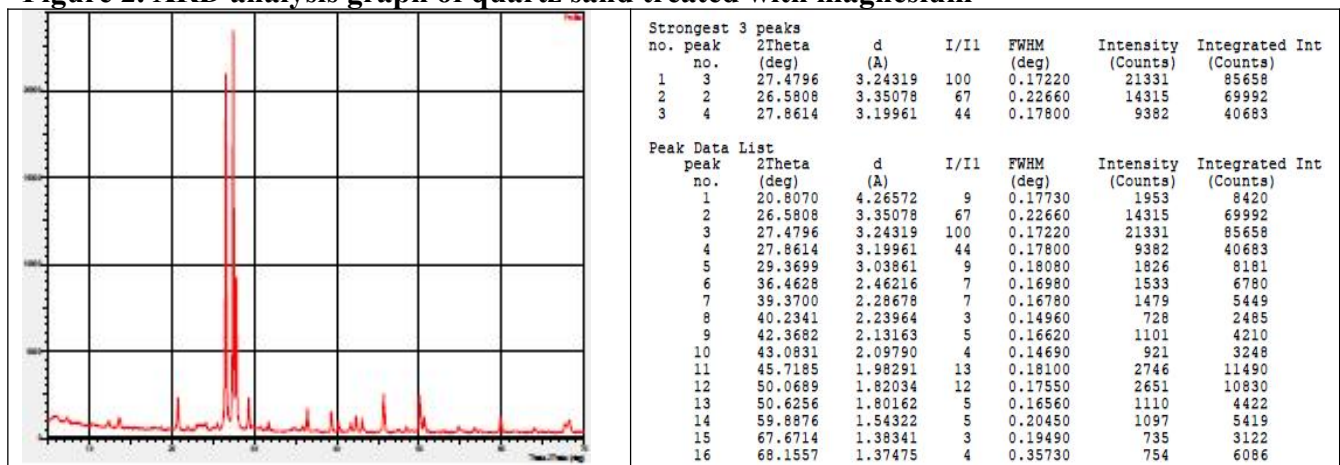


Figure 3. XRD analysis graph of quartz sand treated with aluminum

**Analysis of results**

As can be seen from the graphs above, the intensity was relatively high when the X-rays were incident at an angle of 25°-30°. It was found that the intensity at these incidence angles was 22163 in natural quartz sand, 29877 when refracted with magnesium, and 21331 when refracted with aluminum. The separation yield of technical Si was found to be 58% when reduced with magnesium and 43% when reduced with aluminum.

Si reacts with Mg at 1300°C due to the formation of magnesium silicide, and in the reaction with Al, the yield was lower due to the lower temperature.

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