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INSTALATION FOR GROWING ARTIFICIAL CORUNDUM CRYSTALS

The company **«KELMOS Enterprise Limited»** as part of "DARA GROUP" holding produces installations for growing artificial corundum crystals (synthetic sapphires), of industrial production.

The installations used for sapphire growth, have been developed by Ukrainian scientists. They are capable to produce sapphire crystals from the sintered aluminum oxide by Kiropulos method, weighing from 35 to 85 kg. This installation has is the **best installation for sapphire crystal growing among the parallels**.

«KELMOS Enterprise Limited» can make **deliveries anywhere in the world**, on any conditions of Incoterms.

Parameters of "Omega M200" Installation	Parameters of "Omega M300" Installation
Aimed for growth of synthetic corund by method GOI(Kiropulos) diameter to 230 mm height to 330 mm , weight from 35 to 60 kg. Figures of installation are in conformity with below parameters: 1. heating method – resitive 2. working surface – vacuum, Pa $1x10^{-2}$ 3. speed of the rod: 0.01 mm/hour min 0 max 20 4. speed of high speed of the rod: 20mm/hour 5. speed sharpness +-2% 6. rod frequency (rotations/hour): min 0 maz 4 7. working rod move 150mm 8. Accuracy in stabilization of voltage on heater % From 0.2V to 5V +-2 From 5V to 7V +-1 From 7V to 11V +- 0.1 9. Microclimate in an apartment where equipment is exploited: it is a temperature - 20±5 it is relative humidity, no more - 90% 10. 10. A watts-in is maximal – 100 kvt nominal – 60 kvt Technical requirements to exploitation of equipment: 1. installation area- 9 sq. m. 2. availability of three phase four rods network(with zero cable) voltage 380V frequency 50Gz 3. availability of unsolted water with pressure 1,5..3,0±0,5x10^5 Pa (1,5..3,0±0,5 kg/sm^2) 4. wate temperature not more then 25º C with discharge not more then 6 $м^2$/hour 5. availability of Nitrogen clear GOST 9293-74 with pressure 0,5x10^5 Pa (0,5kg/sm^2) or Argon GOST 10157-79 with pressure 0,5x10^5 Pa (0,5kg/sm^2) in valume 0,5$м^3$ for process.	Aimed for growth of synthetic corund by method GOI(Kiropulos) diameter to 300mm height to 450mm, weight from 60 to 85kg. Figures of installation are in conformity with below parameters: 1. heating method – resitive 2. working surface – vacuum, Pa $1x10^{-2}$ 3. speed of the rod: 0.01 mm/hour min 0 max 20 4. speed of high speed of the rod: 20mm/hour 5. speed sharpness +-2% 6. rod frequency (rotations/hour): min 0 maz 4 7. working rod move 150mm 8. Accuracy in stabilization of voltage on heater % From 0.2V to 5V +-2 From 5V to 7V +-1 From 7V to 11V +- 0.1 Technical requirements to exploitation of equipment: 1. installation area- 9 sq. m. 2. availability of three phase four rods network(with zero cable) voltage 380V frequency 50Gz 3. availability of unsolted water with pressure 1,5..3,0±0,5x10^5 Pa (1,5..3,0±0,5 kg/sm^2) 4. wate temperature not more then 20±5º C with discharge not more then 6 $м^2$/hour 5. availability of Nitrogen clear GOST 9293-74 with pressure 0,5x10^5 Pa (0,5kg/sm^2) or Argon GOST 10157-79 with pressure 6. 0,5x10^5 Pa (0,5kg/sm^2) in valume 0,5$м^3$ for process.

Complectation: 1. appliance complect 2. heating module complect: - crucible	Complectation: 3. appliance complect 4. heating module complect: - crucible
Total cost of installation:	**Total cost of installation:**

THE PROCESS OF SAPHIRE GROWTH

Chemically pure alumina powder is used as the seed materials. The unique technology of pretreatment of raw materials enables to grow the **sapphire with the content of pure aluminum oxide 99.999%**. The starting material is placed in an installation that creates the optimal conditions for growing sapphire crystals.

The whole process of sapphire crystal growth is about 15 days and maintained by an automatic control system.

The essence of an improved Kiropulos method is that the sapphire crystal as though grows and gets deeper into the melt and assumes cylindrical shape during the crystallization through the formation of shrinkage cavity. The appearance of shrinkage cavity is due to the difference in the densities of liquid and solid sapphire (3 and 4 g / cc, respectively). Maintain the required diameter of the crystal is carried out by automatic movement of the seed crystal (without rotation). The crucible during the process is stationary. The speed of the crystal withdrawal is much lower than the speed of crystallization. As a result, there is not the whole crystal in the melt, but only a small layer adjacent to the growing surface. The temperature gradient, which provides crystal growth, is achieved by the construction of a heating module and making the crystallization front wedge-shaped.

Obtainment the melt in the crucible is carried out by resistive heating. Power reducing on the heater is carried out using precision power control system.

The cooling process of the crystal is almost at the same growth zone within the crucible. **This method allows growing crystals with minimal mechanical stress**.

The company Kelmos also possesses cutting and polishing technology of sapphire crystals, which is an important part of production.

APPLICATIONS:

At present, there is a great deficit of sapphire crystals in the world. **Sapphire crystals are widely used in microelectronics, optics, rocket engineering, aircraft engineering, space field, watches production, production of lighting equipment** and other industries.

- Optics. Sapphire is a well - known material for optical parts with such special requirements as:
  - windows for high temperatures and high pressures processes;
  - windows for alkali and acid environments;
  - high temperature optics;
  - UV and IR radiation - proof optics;
- Industry and precision machinery. Sapphire used in:
  - wear - proof parts (fiber guides, watch stones);
  - pressure sensors;
- Semiconductors. Sapphire is an unique material for semiconductor substrates in some areas of application:
  - radiation-resistant chips for space and nuclear power plant;
  - new high speed memory chips and high frequency chips (silicon - on - sapphire (SOI) chips);
- Optoelectronics. Sapphire is a main substrate material for light emitting diodes (LEDs) and solid state lighting (SSL) devices. The most promising areas for high energy LEDs and SSLs are:
  - signalling devices;
  - traffic lights;
  - automobile lighting;
- Medical equipment. Sapphire parts used in:
  - transparent and ultra thin blades for surgery;
  - chemically inert optical parts for diagnostic devices with high temperature sterilization ;

Sapphire is suitable material for these applications due to:

- high transparency;
- high melting temperature (2050 °C);
- high resistance to radiation;
- excellent resistance to acids and alkali;
- transparency under UV radiation (UV - proof) used in watch glass mounting;
- low friction;
- wear proof;
- ability to accommodate guest elements into crystal lattice;
- high dielectric constant;
- crystal lattice match with silicon;
- crystal lattice match with gallium nitride (GaN) - basic material for LED and SSL;
- high durability and hardness (the second after diamond);
- chemical and bio compatibility.

In 2003 production of synthetic sapphire in the world was 250 tonnes, mostly to the United States and Russia. **There is fewer and less natural corundum** and their production comes expensive year after year. Chemical and physical properties of stone are major in the industry while **synthetic corundum is easily and fully supersedes the natural one.**