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Coolers for Obtaining Crystals

A model of air coolers with a family of movable Tamman's test tubes, installed in a laboratory chamber furnace, crucible furnace and tube furnace, which allows regulation and simultaneous crystallization of several substances at different temperature gradients and crystallization rate intervals, for obtaining crystals are presented.

Keywords: model, air cooler, crystal growth

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We have modelled the interior and exterior of an air cooler (the path and rate of the air stream) and installed it in a laboratory chamber furnace (Fig. 1), for the regulation of temperature gradient and different crystallization rates in the family of Tammann test tubes, with the purpose of obtaining crystals of a family of compounds with unknown crystallization parameters (CABRIC et al. 1998). The procedure involves firstly an increase of the voltage until the substance in each of the test tubes are completely melted. Then, while a constant furnace voltage is maintained, a small air flow is introduced through the cooler and crystallization starts at the bottom of Tamman's test tubes. With the increase of the air flow during several hours, the crystallization front moves to the other end of the test tube.

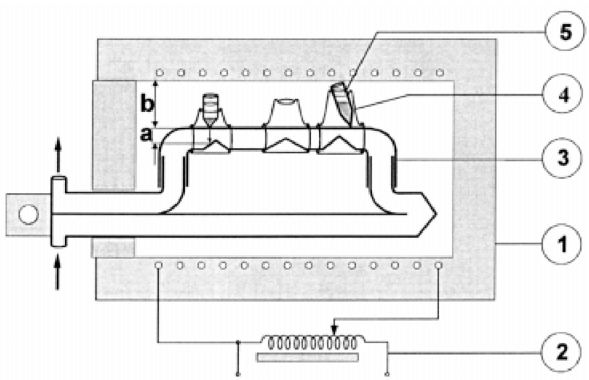

Fig. 1: A chamber furnace for obtaining crystals. (1) laboratory chamber furnace, (2) continuously changeable transformer, (3) air cooler ("cold bench i.e. key"), (4) movable rings (5) Tamman's test tubes (family group).

Different air flow rates below Tamman's test tubes, which are regulated by different cross-sections (**a**), i.e. positions of movable rings with test tubes, simultaneously regulate different intervals of crystallization rates (see formula (1) of CABRIC et al. 1994) along test tubes. Defect "flowing" towards test tube walls is regulated by the angle between the test tube axis and crystallization rate direction (inclining test tube (Fig. 1)). The temperature gradient is regulated by the distance (**b**), which is performed by moving part of the cooler ("cold bench"). Tamman's test tubes of various shapes and dimensions (WILKE) can be mounted on the rings, i.e. simultaneously tested. By varying the shape and dimensions of the movable part of the cooler, a family of "cold bench" can be modelled for tests in a wider range of temperature gradients and crystallization rate intervals. An expanded cooler can be modelled for simultaneous regulation of different temperature gradients ("crystallization artificial limb"). The cooler can also be modelled for regulating different crystallization fronts and rates in crucible columns below the cooler so that crystallization starts on the surface of the melt, for obtaining crystals of compounds with a layered crystal structure.

A model of an air cooler with a family of curved Tamman's test tubes, which allows a simultaneous crystallization of several substances at different temperature gradients and crystallization rate intervals in a laboratory crucible furnace is presented on Fig. 2. The crystallization procedure is the same as described above for the crystallization in a chamber furnace.

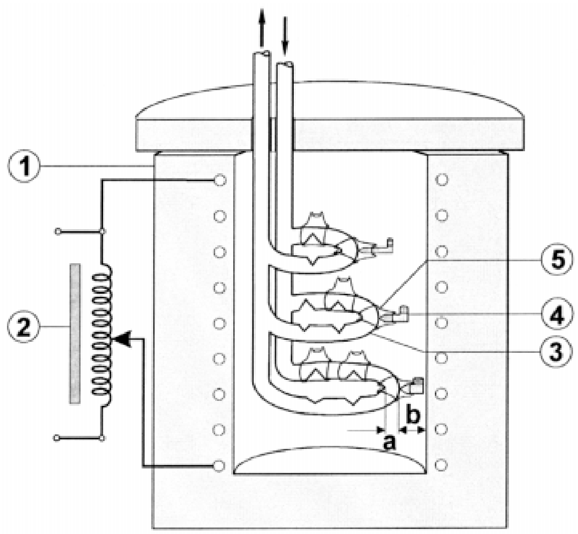

Fig. 2: A crystallization cooler in a crucible furnace. (1) laboratory crucible furnace, (2) continuously changeable transformer, (3) air coolr ("three cold benchs in the form of horse-shoes"), (4) movable rings and (5) curved Tamman's test tubes.

The crystallization rate in each test tube is regulated by the cross section of the air flow (**a**), and temperature gradient is regulated by distance (**b**). For simultaneous crystallization tests of different test tubes, temperature gradients and crystallization rate intervals for obtaining crystals in a laboratory tube furnace, an air cooler is presented on Fig. 3. The crystallization rate in each test tubes is regulated by the cross-section of the air flow (**a**), which is adjusted by translatory and rotationary movement of rings holding test tubes. Movement of the test tube holder along the translation mechanism can be used to regulate different crystallization rates in Tamman's test tubes on one ring (crystallization rates spiral). The temperature gradients are regulated by the distance (**b**), i.e. by rotation movement of the furnace and/or turning the ring with test tubes. This cooler with curved Tamman's test tubes can also be installed into a crucible furnace, or into chamber furnace (in a horizontal position). In a chamber furnace several different coolers can be installed (a family group of "cold keys" (Fig. 1) or a family group of " cold fingers" (Fig. 3)) which then extends the number of simultaneous crystallization tests of different test tubes, temperature gradients, crystallization rate intervals (CABRIC et al. 1994) and substances, for obtaining crystals by a low budget and modular crystallization apparatus.

This method with a model of air cooler installed in a laboratory chamber furnace which is shown in Fig. 1, was applied for obtaining crystals of a family newly-synthesized compounds with the common formula $BaM_2(XO_4)_2$, where M = Mg, Co or Ni and X = P or As (CABRIC et al. 1998), to be able to investigate their physical properties.

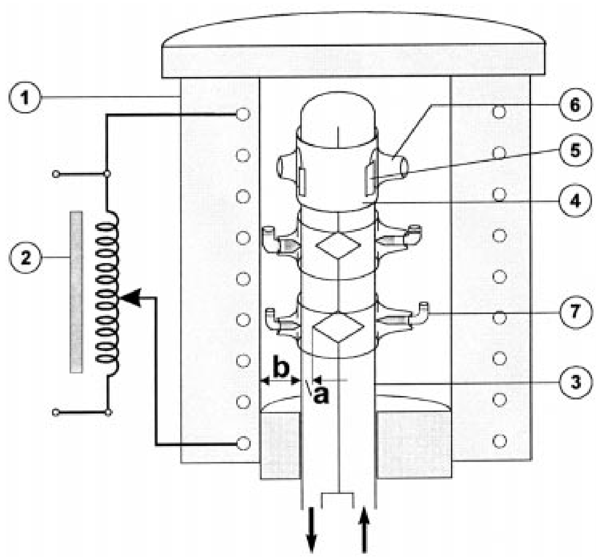

Fig. 3: Crystallization regulation in a tube furnace. (1) electroresistant tube furnace, (2) continuously changeable transformer, (3) air cooler ("cold finger i.e. tree"), (4) moving rings, (5) test tube holder guiding mechanism, (6) test tube holder and (7) curved Tamman's test tubes.

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