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Design and Construction of a Small Vacuum Furnace

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The general high temperature furnaces are usually used in the atmosphere, a sample it consequently contacts the air that has pollutants, there makes the sample impure by exposure in a particular way to be not required and difficult to control gas that requires to an interaction within a sample. A heating technique in a vacuum environment is required to fix the referred problems. The purpose of this research is designing and construction of a small vacuum furnace. A cylindrical graphite was chosen as the material of the furnace and the cylinder aluminum sheets employed to prevent the heat radiation that transfers from the furnace to the chamber wall. Using a rotary pump, the system can be pumped down to 30 mTorr, the heating wire drives the graphite furnace to 700 °C while the temperature of the chamber enclosure remains relatively low. Heat losses from the graphite furnace by conduction, convection, and radiation were analyzed. The dominating heat loss was found to be caused by the blackbody radiation, which can thus be used to estimate the relationship between graphite furnace temperature and the drive power needed. The cylindrical graphite furnace has an inner diameter of 44 mm, the outer diameter of 60 mm and 45 mm in height, only 355.5 W of power is needed to drive the furnace to 700 °C.

Keyword: vacuum furnace, thermal analysis, graphite radiation, radiation shielding.

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