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Suliudation experiments of metallic iron under protoplanetary disk conditions

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Sulfur is a major volatile element in the solar system, and it shows various degrees of depletion in chondrites reflecting fractionation of volatile elements between solids and gas in the early solar system. Elemental fractionation of volatile elements can be attributed to incomplete condensation of volatiles into solids due to dispersal of disk gas. In order to discuss such incomplete condensation of volatiles, it is of much importance to understand condensation kinetics of volatiles, i.e., sulfidation kinetics of metallic iron in the case of sulfur.

Sulfidation experiments of metallic iron were performed under protoplanetary disk conditions using a vacuum gold furnace in order to investigate kinetics of sulfidation of Fe metal at low pressures. The heating unit of the furnace consists of a resistance metal heater and a surrounding gold mirror tube that reflects infrared light from the heater effectively to heat a sample in the chamber. The vacuum chamber of the furnace is a silica glass tube, which makes it possible to introduce a reactive gas such as H2S in the chamber.

Preliminary results of experiments performed at 770 K in the gas mixture of He and H2S, of which S/He ratio is set at the solar ratio, at the total pressure of 1 Pa show that sulfidation occurs with nucleation of tiny iron sulfides and subsequent growth up to about 1 micron in size for 24-132 hours. Such observed sulfidation behavior appears to be more sluggish than those observed in previous experiments done at one atmosphere total pressure (Lauretta et al., 1996). Details of kinetics of nucleation and growth of iron sulfide will be discussed at the meeting.

Keywords: troilite, protoplanetary disk, kinetics, metallic iron, sulfidation