SIMULATION OF GAS-GRAIN COLLISIONS: A MECHANISM FOR CHONDRULE FORMATION.

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Introduction: The exact process of chondrule formation is still not known. The most common scenarios are formation in a protoplanetary nebular environment: e.g. X-wind model [1] or nebular shock fronts, where precursor grains are heated by collisions with gas [2]. Most chondrules probably have been heated to 1500–1600 ºC, followed by a cooling rate of usually between 10 to 1000 ºC/h [3]. In this part of our study about the formation of chondrules by shock processes, we try to simulate the formation of chondrules by gas-grain collisions in a nebular environment.

Earlier, related studies usually did not result in chondrule-like objects[4]. In a first series of experiments using plasma arcs, we produced successfully spherical silicate droplets in a simple set-up under atmospheric conditions. These chondrule-like objects already show similarities to actual chondrules [5]. In a second series, the experiments take place in an environment closer to the earlier solar nebula, at low pressure and a reducing environment..

Techniques: A plasma arc is generated at atmospheric pressure using a low voltage solid state switching circuit to drive a Tesla coil (natural frequency ~ 325 kHz). The gas temperature was determined in an earlier experiment through fitting of modeled spectra to observed emission spectra: At 25W, the gas temperature is in the region of >2100°K.

The plasma generator is placed in an environmental chamber at the PSSRI/Open University. With the help of a remote controlled dispenser, starting material (mixture of olivine, feldspar, metal and carbon) is dropped through the arc) under varying atmospheres (air and N2) at changing pressures of 5×10-1, 1×10-1, 4.8×10-2, 5×10-3 bar.

The run products are recovered below the arc and analyzed using SEM/EDX for their structure and chemical composition.

First Results: The first run did show interaction of the material with the plasma arc. However, preliminary screening of the run products with SEM/EDX indicates only few melt droplets, which are difficult to identify in the original material [5]. Here we will present the results of a new series of experiments with varying starting compositions.

References: [1] Shu et al. (2001) *The Astrophysical Journal* 548: 1029-1050. [2] Desch and Connolly Jr. (2002) *Meteoritics & Planetary Science* 37:183-208. [3] Zanda B. (2004) *ESPL* 224:1-24. [4] Güttler et al. (2008) *Icarus* 195: 5094-510. [5] Morlok et al. (2011) LPSC 42, abstract#1081.