FORMATION OF ZONED METAL GRAINS IN HAH 237

C. M. Duffy[1,2], P. A. Bland[1,2], S. S. Russell[1,2], A. T. Kearsley[2], D. J. Prior[3], E. Mariani[3], [1]Impact & Astromaterials Res. Centre (IARC), Imperial College London, South Kensington Campus, London SW7 2AZ, UK. E-mail: c.duffy07@imperial.ac.uk. [2]Dept. Mineralogy, Natural History Museum, Cromwell Road, London, SW7 5BD, UK. [3]Dept. Earth & Ocean Sci., University of Liverpool, 4 Brownlow Street, Liverpool, L69 3GP, UK.

Introduction: Compositional zoning of metal grains occurs in CH and CB_b meteorites: Ni and Co increase from grain rim to core while Cr content decreases from rim to core [1]. The cores of these zoned grains contain abundant refractory siderophile elements, and are depleted in volatile elements compared to CI chondrites [2, 3]. Condensation, either from the cooling solar nebula [1], or from an impact-generated vapour plume [4], combined with diffusion processes [2], are thought to be responsible for the observed profiles. Although the composition and petrography of metal in these meteorites has been explored in some detail, crystallographic data are sparse [5]. EBSD offers an effective means of quantifying crystallography at high spatial resolution, in silicates [6] and metals. EBSD has not been applied to zoned metal grains to date. We chose to explore the thermal history of individual grains using this technique.

Method: SEM-EDS analysis revealed zoned grains in a polished thin section of CB_b HaH 237. The sample was prepared for EBSD analysis, and the same areas mapped, revealing the crystal structure of grains. Further processing generated grain boundary and texture component maps.

Results: SEM imaging of HaH 237 reveals visible elongation and deformation of grains. EBSD band contrast mapping of zoned metal grains exposes a sub-grain microstructure with average diameter ~4 µm. These sub-grains are regular in shape with almost circular boundaries. Misorientation angles between sub-grains increase from rim to core. A band contrast map was superimposed with three texture component layers corresponding to maximum boundary angle deviations of 20º, 40º and 60º. With no semi-transparency applied, the grain displayed an approximate radial pattern.

Discussion: Smooth and regular-sized internal sub-grains are consistent with a diffusion formation process. The misorientation boundary pattern for sub-grains suggests that the outer regions of the metal grain were more subjected to stress and/or deformation than the core. Such a well defined core-mantle sub-structure is unusual. Sub-grains nearer the core are less deformed, suggesting they were protected from altering conditions. Chronologically ordering these findings suggests the following formation scenario: (i) metal condensed, (ii) underwent diffusion, and (iii) a heating event occurred which deformed the overall structure of the sample and caused local stress of the outer sub-grains forming high angle boundaries near the rim. Heating event temperatures were not high enough to affect the internal substructure.

References: [1] Meibom, A. et al. 1999. *Journal of Geophysical Research* 104:22,053-22,059. [2] Campbell, A. et al. 2001. *Geochemica et Cosmochemica Acta* 65:163-180 [3] Campbell, A. and Humayun, M. 2004. *Geochemica et Cosmochemica Acta* 68:3409-3422. [4] Wasson, J. & Kallemeyn, G. W. 1990. *Earth and Planetary Sci. Lett.* 101:148-161 [5] Goldstein, J. et al. 2007. *Meteoritics & Planetary Science* 42:913-933. [6] Watts et al. 2006. *Meteoritics & Planetary Science* 41:979-1117.