PRELIMINARY EXAMINATION OF THE STARDUST INTERSTELLAR COLLECTOR: AL FOIL I1044N,1

J. Leitner, C. Allen, S. Armes, S. Bajt, A. Ball, R. Bastien, H. Bechtel, J. Borg, F. E. Brenker, J. C. Bridges, D. E. Brownlee, M. J. Burchell, M. Burghammer, A. Butterworth, R. Chater, P. Cloetens, G. Cody, A. Davis, T. Ferroir, C. Floss, G. Flynn, D. Frank, Z. Gainsforth, E. Grün, P. R. Heck, J. Hillier, P. Hoppe, F. Hörz, L. Howard, B. Hudson, G. R. Huss, J. Huth, A. T. Kearsley, B. Lai, M. Landgraf, L. Lemelle, H. Leroux, L. Nittler, R. Ogliore, M. C. Price, F. Postberg, S. Sandford, S. Schmitz, G. Silversmit, A. Simionovici, R. Srama, F. Stadermann, T. Stephan, R. Stroud, S. Sutton, R. Toucoulou, M. Trieloff, J. Trigo-Rodriguez, P. Tsou, A. Tsuchiyama, T. Tyliczszak, B. Vekemans, L. Vincze, J. Warren, A. J. Westphal, M. E. Zolensky. Affiliations are listed at http://ssl.berkeley.edu/~westphal/ispe.

Introduction: On its way to comet 81P/Wild 2, NASA's Stardust mission collected particles from the contemporary interstellar dust stream. Like for the cometary tray, the interstellar collector's aerogel cells are held together with Al foils that make up ~15% of the total exposed surface [1]. Recent estimates of interstellar dust fluxes suggest that ~15 particles with diameters > 0.3 µm may have impacted the exposed foil area of 153 cm^2 with relative impact velocities of up to 26 km/s. Crater diameters are estimated to lie between 0.3 µm and 1 µm [2,3].

Technique and Protocol: By following the contamination monitoring procedure described in [3], the suitability of the LEO 1530 FE-SEM at Max Planck Institute for Chemistry for automated high-resolution crater search was verified. According to the ISPE guidelines, scanning is performed at a resolution of ~60 nm/pixel, with an acceleration voltage of 5 kV. Individual images are 60×60 µm² (1000×1000 pixels at 8 bit grayscale) in size, with an integration time of 14 s (i.e., 0.0039 s/µm²). After manually setting a starting position, a pre-defined grid of positions is imaged and saved automatically. An overlap of 6–7 % is included in the step width between individual image positions to ensure a complete coverage of the selected foil area. Test runs showed that it is possible to scan arrays of up to 20×20 images (representing 1.2 mm^2 with consideration of image overlap) and stay in focus if the foil is not too heavily bent or crinkled. Then, the next starting position has to be set. Complete scanning of a large (30 mm length, area ~56 mm^2) foil results in ~18,000 high-resolution images. Examination of these images has to be done manually.

Results: To date, about 37 % of foil I044N,1 have been scanned and manually inspected for impact craters. The SEM survey of this foil is complicated by lots of aerogel debris sticking to the foil surface. Three promising impact crater candidates have been found, with diameters of ~900 nm, ~600 nm, and 390 nm×300 nm, respectively. Determination of the chemical composition of possible crater residue by Auger spectroscopy and a high-resolution investigation by SEM are planned for a later ISPE phase.

References: [1] Tsou P. et al. (2003) JGR 108, 8113. [2] Westphal A. et al. (2008) LPSC XXXIX, #1855 [3] Kearsley A. T. et al. (2010) LPSC XLI, #1593.