VACUUM UV LASER ABLATION OF GENESIS TARGET MATERIALS: RESULTS FROM GOLD-ON-SAPPHIR ANALOGS. P. Burnard[1] L. Zimmermann[1] and B. Marty[1]. [1]CRPG-CNRS, 15 rue Notre Dames des Pauvres, BP20, 54501 Vandoeuvre, France

Introduction: Avoiding atmospheric contamination is paramount when analyzing materials for nitrogen or the noble gases [1]. The e-beam technique of depositing metals on sapphire or silicon substrates results in a layer between substrate and deposited material enriched in atmospheric N. Naturally, it is desirable to find a technique that permits extraction of N and the noble gases without disturbing this contaminated layer. One obvious choice is to use a short wavelength laser to ablate the metal without disturbing the contaminated layer. In theory, by ablating the minimum of material with each laser pulse should in addition allow surface-adsorbed atmospheric contaminants to be removed from the targets while leaving implanted solar wind N undisturbed at depths of several 10s of nm; once the surface layer has been removed, laser power can be increased to extract the solar wind N yet without disturbing the potentially N contaminated interface between the Au coat and the sapphire base.

Laser Description: To this end, a 157 nm (UV) F2 excimer laser (OptexPro, by LambdaPhysik) was purchased. A 30x demagnification creates a focused rectangular spot of 100 x 50 μm. The samples are translated beneath the fixed beam in order to raster larger areas (1 cm^2 is required for N isotope analysis). The beam path has to be continually flushed with N_2 (otherwise the beam is absorbed by O_2 and water vapor in the air). Up to 5 J cm^{-2} per pulse in the focused spot is possible, sufficient to ablate Au-coated glass wafers (used as analogs of AuOS) (see figs 1 and 2.

Results: Our objective was to remove less than 5nm of Au with each laser pass. This technical objective has now been achieved: Atomic Force Microscopy demonstrates that layers as thin as 5nm can be ablated with energy densities of 1.4 Jcm^{-2}; either increasing the number of pulses, or increasing the pulse energy, reproducibly produces deeper ablation craters.

Future Work. The laser technique will initially be used to measure blank N_2 levels in pieces of 'flight-spare' AuOS (system blanks are satisfactorily low). These results should be available before LPSC. If satisfactory, we propose to measure N_2 in combination with Ne and Ar in GENESIS AuOS targets in order to estimate the N isotopic composition of the wind. If the AuOS N blanks are too high to permit analysis, we intend to try other materials (AlOS, for example) as the laser should be equally effective for all metals.

References:

[1] Jurewicz, A., Burnett, D. and others (2003). The Genesis Solar-Wind Collector Materials. *Space Science Reviews*, 105: 535-560.

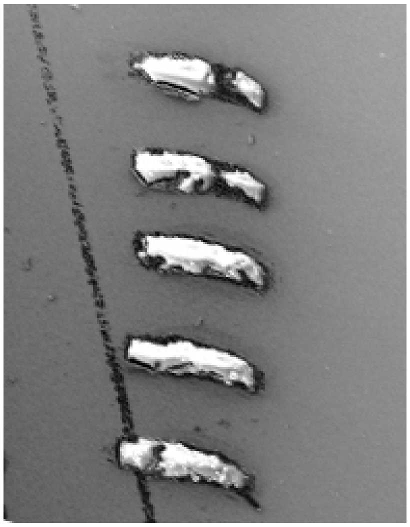

Figure 1 SEM image of laser ablation pits in AuOS. Each pit measures c. 100 x 50 μm. Test plates consisting of variable thicknesses of Au (25 – 200 nm) deposited on glass wafers were used in order to determine the energy density necessary to completely remove the gold, allowing the pit to be imaged as an atomic weight contrast by SEM. In this experiment, high energy densities (c. 2 J cm^{-2}) allowed the 100 nm thick Au coating to be removed.

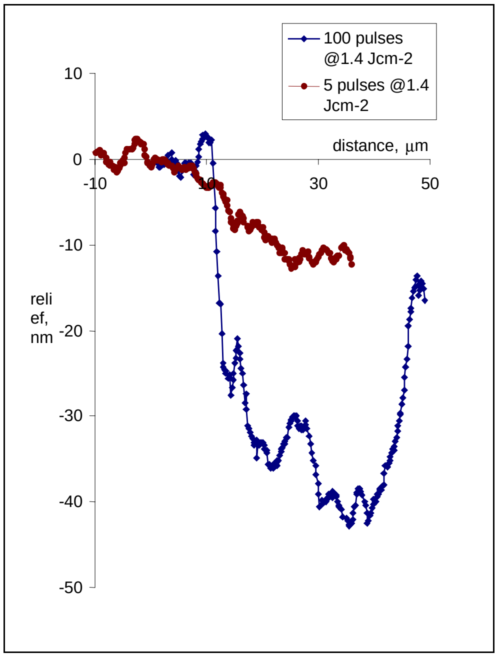

Figure 2. AFM profiles across pits ablated in Au-coated glass wafers (thickness of Au > 100nm). Two profiles are shown, both created using energy densities of 1.4 J cm^{-2}, but with either 5 or 100 pulses (max rep.

rate = 200 Hz). Profiles are 10 point moving averages. The ≈ 5nm relief at the base of the deeper pit is likely real, resulting from inhomogeneities in the laser beam (beam homogenizers do not exist for 157nm lasers).