Analysis of NASA Genesis Mission Samples by Total Reflection X-ray Fluorescence and Grazing Incidence X-ray Fluorescence

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The NASA Genesis mission took place between August 8, 2001 and September 8, 2004. The main mission goals were to collect solar wind material for accurate determination of elemental and isotopic abundances within the sun’s corona region and to create a repository of solar wind samples for future analyses. A suite of high sensitivity instruments was developed specifically for this purpose and the data obtained from those measurements are intended to advance our understanding of solar system formation. Current knowledge is based on model calculations which rely mainly on chondrite data. However, it is known that some elements undergo selective fractionation processes impacting the accuracy of those data and requiring a more robust data set. During the mission highly energetic solar wind was implanted in ultraclean collector materials at Lagrange point 1 for 853 days. Upon return the space craft crash landed in the Utah desert due to failure of the landing gear. The crash breached the return capsule and shattered collectors into small fragments while also exposing those to space craft debris and local soil. As a result the mission goals have become more challenging, but not impossible to complete. Solar abundances of selected elements such as Ar and Ne could be determined already as those samples showed relatively little contamination. Unfortunately, the majority of samples suffer not only from contamination on the surface, but also from surface damage potentially harboring contaminants. Different cleaning methods have been devised to remove surface dirt, but some of the contamination is extremely resistant and presents major challenges for both cleaning and subsequent analysis. In order to aid in cleaning success, our laboratory has developed a reliable procedure for pre and post cleaning observation of the Genesis collectors by TXRF. We will discuss the efficiency of different cleaning approaches on selected collector materials from the perspective of TXRF. Recently we also employed TXRF for discrimination between surface dirt and implanted solar wind using its angle scan feature and specially prepared implant samples. In summary, TXRF data are important for selection of suitable samples to accurately quantify solar wind with secondary ion mass spectrometry (SIMS) and possibly by grazing incidence X-ray fluorescence (GIXRF). The latter one was employed at the GeoSoilEnvironment Consortium of Advanced Radiation Sources (GSECARS) at the Advanced Photon Source (APS) for determination of Mn, Fe, and Ni fluences on TXRF preselected samples. GIXRF data will be discussed in light of collector material choice and limitations e.g. due to sum peaks originating from the bulk material and from a combination of collector material and remnant contamination.