Cratering Studies in Polyvinylidene Fluoride (PVDF)

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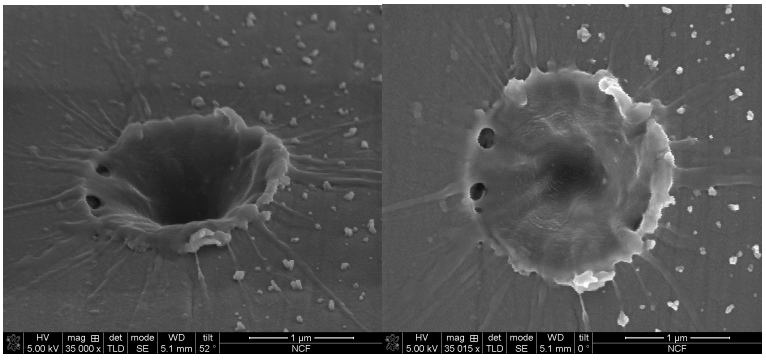
Abstract. Thin plastic films, such as Polyvinylidene Fluoride (PVDF), have been used as protective coatings or dust detectors on a number of missions including the Dust Counter and Mass Analyzer (DUCMA) instrument on Vega 1 and 2, the High Rate Detector (HRD) on the Cassini Mission, and the Student Dust Counter (SDC) on New Horizons. These types of detectors can be used on the lunar surface or in lunar orbit to detect dust grain size distributions and velocities. Due to their low power requirements and light weight, large surface area detectors can be built for observing low dust fluxes. The SDC dust detector is made up of a permanently polarized layer of PVDF coated on both sides with a thin layer (≈ 1000 Å) of aluminum nickel. The operation principle behind this type of detector is that a micrometeorite impact removes a portion of the metal surface layer exposing the permanently polarized PVDF underneath. This causes a local potential near the crater changing the surface charge of the metal layer[1]. The dimensions of the crater determine the strength of the potential and thus the signal generated by the PVDF. The theory exhibits a bias as a function of experimental charge, which can be traced to the crater diameter scaling law used. Work is being undertaken to develop a new crater diameter scaling law using iron particles in 52 μm thick PVDF. Samples were brought to the Heidelberg Dust Accelerator and exposed to a selected range of mass and velocities. Samples are being analyzed at the Colorado Center for Lunar Dust and Atmospheric Studies (CCLDAS) using 3D reconstruction photogrammetry using stereo pairs taken in a scanning electron microscope (SEM) and cross sections taken in a focused ion beam (FIB). Further work is planned at the CCLDAS dust accelerator.



[1] A. Poppe, B. Jacobsmeyer, D. James, M. Horanyi, *Nucl Instrum Meth A* 622, 583 (2010)