CHARACTERISATION OF TEFLON FEP (HST, LDEF) FOLLOWING LONG TERM EXPOSURE TO LEO

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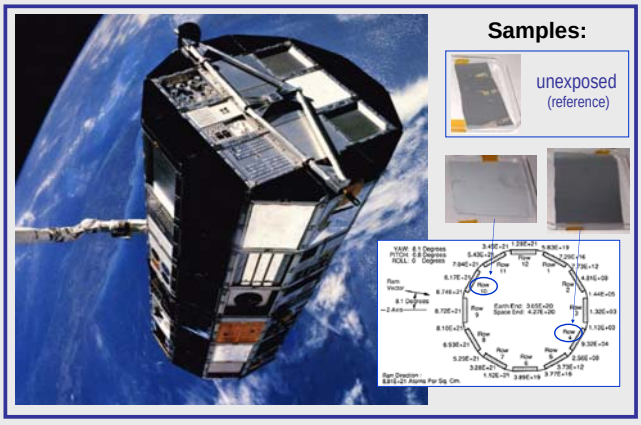
The aging of Teflon® FEP (flourinated ethylene - propylene), an often used exterior spacecraft layer for thermal control in the low Earth orbit (LEO) environment, was determined. Therefore, changes of the morphology of the surface (light microscope), the topography of the surface (3d-profilometry, AFM), mechanical properties (AFM and micro – hardness) as well as the surface composition (ESCA, FTIR and XRD) with samples mounted on the LDEF (5.8 years in space) and with foils brought back to earth from the HST (3.6 and 8.25 years in space resp.) were performed.

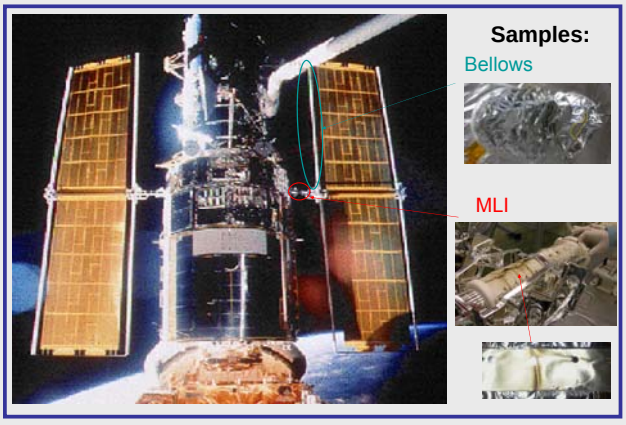
Long Duration Exposure Facility (LDEF)



Influences in LEO:
ATOX, UV – radiation

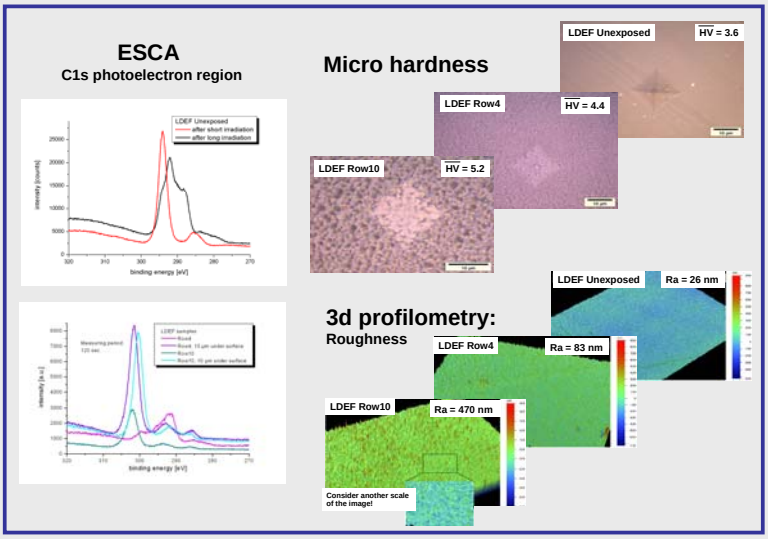
=> Cracks

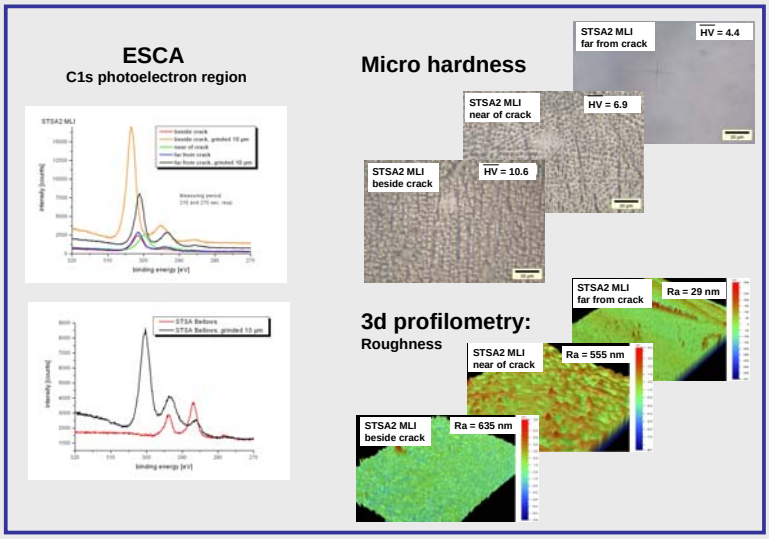
Hubble Space Telescope (HST)



Investigations:

Morphology + topography (LO Microscope, AFM, 3d profilometer)		→ rougher surface
Mechanical properties	(AFM, micro hardness)	→ hardening + embrittlement
Surface properties:	ESCA	→ degradation of C-peak
	FTIR	→ higher C=O content
	XRD	→ higher crystallinity





Conclusions

- LDEF: Micro hardness, roughness – measurements →
  degradation of LDEF Row10 > degradation of LDEF Row4.
  ESCA, FTIR, XRD – measurements →
  degradation of LDEF Row4 > degradation LDEF Row10.
  Possible explanation:
  For polymers an interplay between AO – induced contamination and AO – induced "cleaning" controls the level of contamination. At low AO fluxes, this interplay may lead to a maximal steady-state level of contamination.
  → Low AO-flux can be more hazardous than high flux.

- STSA:
  Strong embrittlement of STSA2 Bellows and STSA2 MLI in the cracked area. Far away from the cracked position, the embrittlement of STSA2 MLI is comparable to the one of STSA1 MLI.

- Weathering HST – materials > Weathering LDEF – materials
- Depth of embrittlement < 10 µm
- Chemical change marginal and hard to detect
  but strong enough to cause mechanical embrittlement.

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