RECENT ACTIVITIES IN SOLAR SAIL TECHNOLOGY

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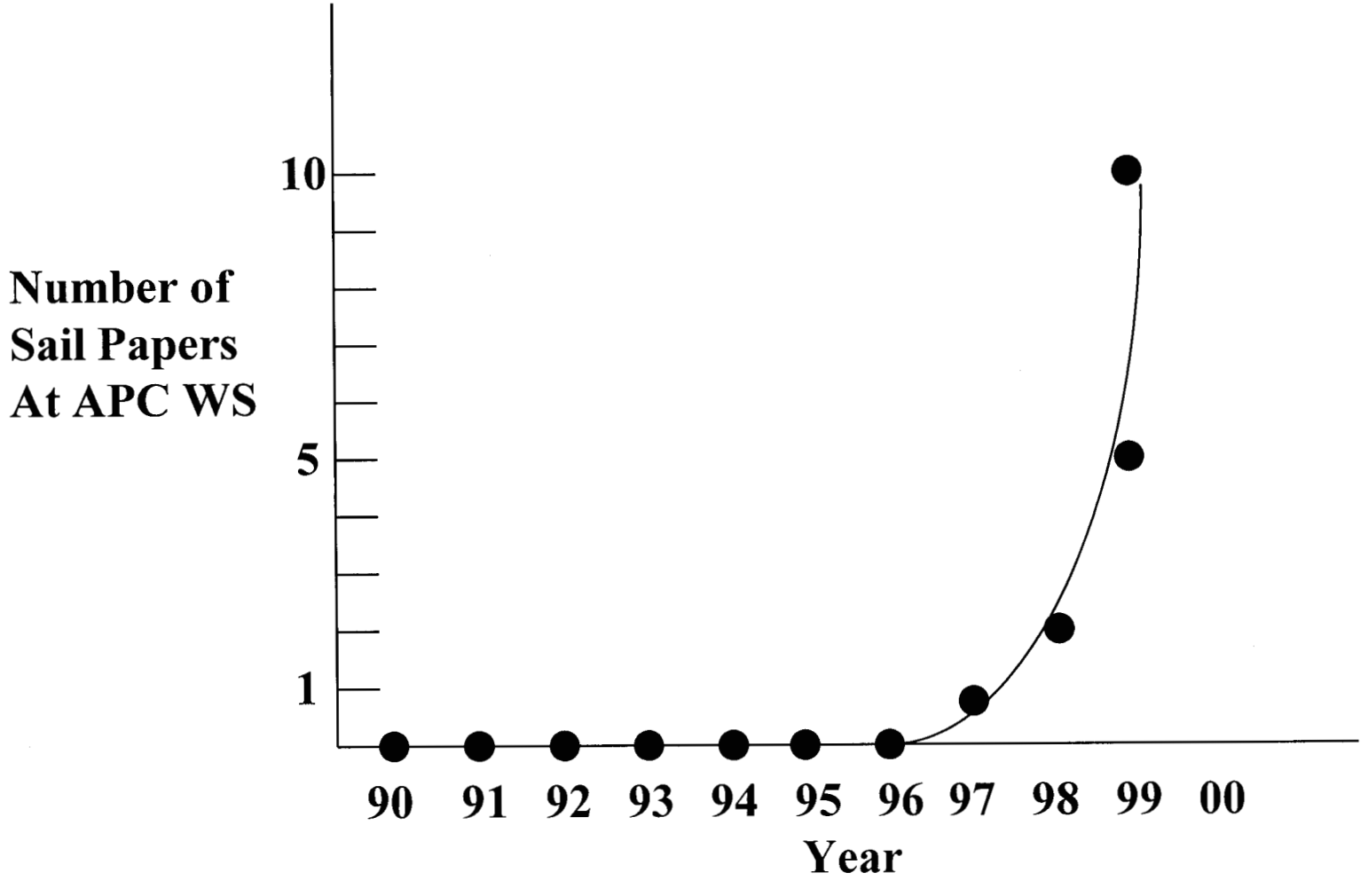
Section 353

June 1, 2000

Sails Are Taking Off



Exciting Sail Technologies Are Being Developed Worldwide

- **Code-R Sponsorship: NASA MSFC and NASA JPL**
  - Advanced carbon microtruss fabrics for ISP precursor missions
  - Space environments analysis and testing, MISSE films experiments
  - Advanced thin film developments (fugitive films, light-weight films)
  - Films testing
  - Sail design, assembly and deployment testing
  - Magsails and other advanced sails , photon/materials interactions
- **Code S Sponsorship:NASA JPL and NASA LaRC**
  - Advanced thin film developments
  - Boom developments
  - Structures and dynamics modeling
- **Sail SBIRs**
  - Carbon fabric, electrochromic surfaces, continuous rolls of CP film (Phase 2)
- **Foreign: LaRC**
  - DLR laboratory model solar sail and deployment test

Programs

SBIRs:

- **Reinforced carbon microtruss**
  - **Uses in-plane fiber strucutres for increased stiffness to weight**
  - **SOA accomplished now: under 4 g/m2 that supports the weigfht in 1 g- the beams are straight over 0.3 m in 1g**
- **Surface carbon membranes for good optical properties**
  - **Graphite and glassy carbon membranes**
  - **2 g/m2 SOA**
- **LaRC SBIR on electrochromic surfaces**
- **LaRC Phase II SBIR on continuous rolls of CP film-up to 2.1 m wide**
- **More SBIRs next year!**

- **Gossamer NRA and Focussed Technology Programs, LaRC Programs Now**
- **MSFC Sail Technology Program, LaRC and Gossamer Programs next year!**


NASA

MSFC APC-52-Hoop Prototype

(sized to fit in Shuttle mid-deck)

Related Work:

- **KC-135 sail Demo proposal by CIT**
- **Deployment test At JPL**

MSFC-supported ISP Carbon Film Development

- **FY 2000 Goals:**
  - **3 g/m^2 reinforced fabric**
  - **Reflectivity of 0.7, emissivity of 0.6**
  - **Operable to 900 K**
  - **Fabric is seamable and foldable**
  - **Scale-up to ~ 1m**

- **SOA**
  - **Fabricated reinforced carbon fabric to 5 g/m^2**
  - **Sparse nets with areal densituy of 0.05 g/ m^2**
  - **Reflectivity and emissivity properties TBD**
  - **Operable temperature is > 1200 K**

Exciting LaRC Materials Developments

1) Metallic silver surfaces can be prepared on polyimide films via internal thermal reduction of soluble silver complexes.

2) The nature of the surface seems to depend of the chemical nature of the silver additive and the thermal treatment of the film.

3) Conductive surfaces appear to require some degree of metal catalyzed degradation of the polymer matrix to build the silver concentration at the surface.

4) The formation of the metal surface and metal particles within the bulk do not seriously degrade the mechanical properties of the films.

5) The thermal stability in air is compromised. However, the metallized films still have a fairly wide useful temperature range.

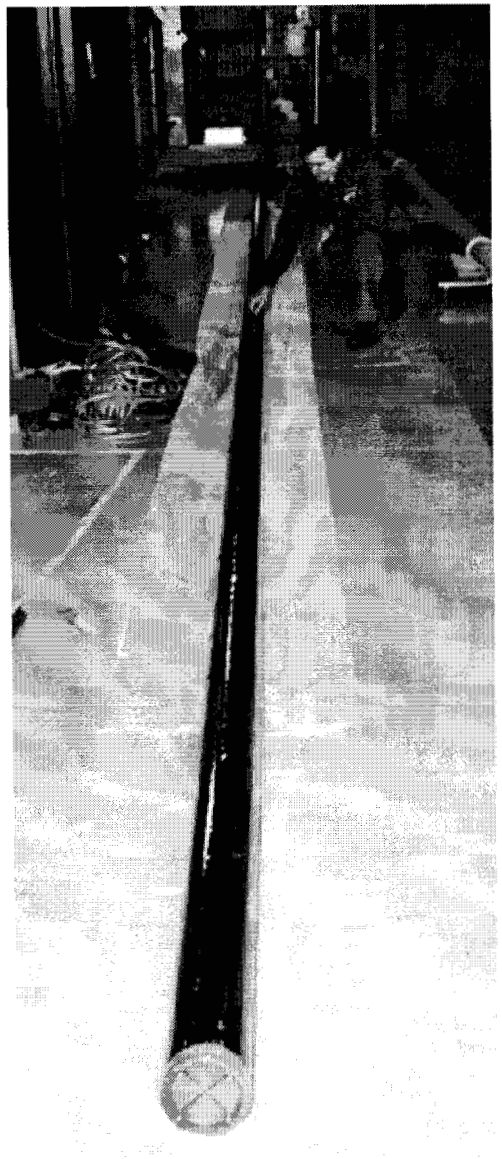
Exciting LaRC Materials Developments-Self Metallizing Films

MIRROR IMAGE

OBJECT

LaRC-supported ILC Dover 13 Meter Rigidizable
Thermo-Set Graphite/Epoxy Column

13 Meter Boom

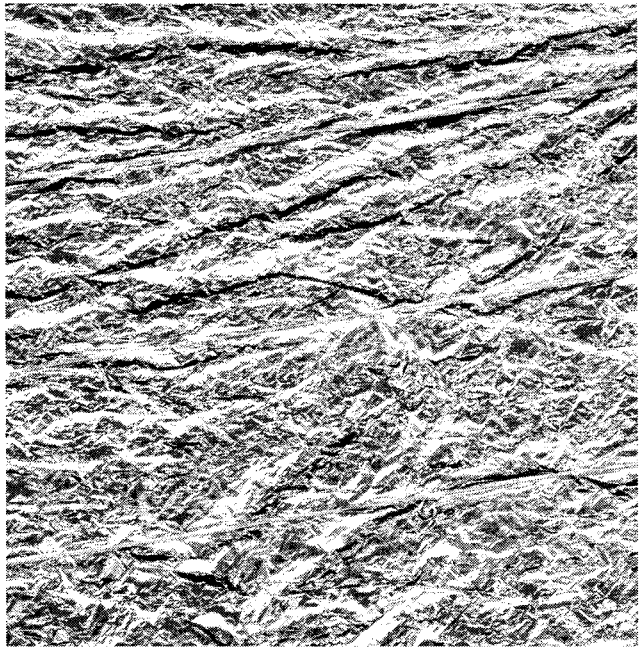


Small Diameter Filament Observation

- **Filaments are very strong and stiff**
- **Small diameter filaments weigh very little**

  1 lb of .0003”(8 μm) diameter filament is 4500 miles long

Orcon Corporation Reinforced Films-2.5 μm Thickness
MSFC-APC
Film weighs under 4 g/m^2



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