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Polyimide foils as backing support for target preparation

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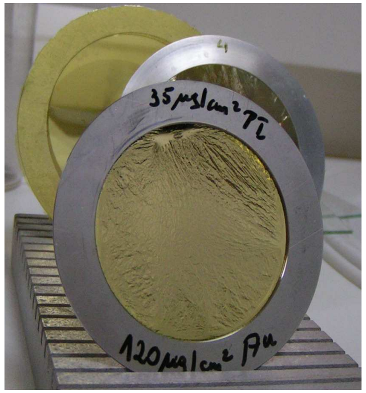
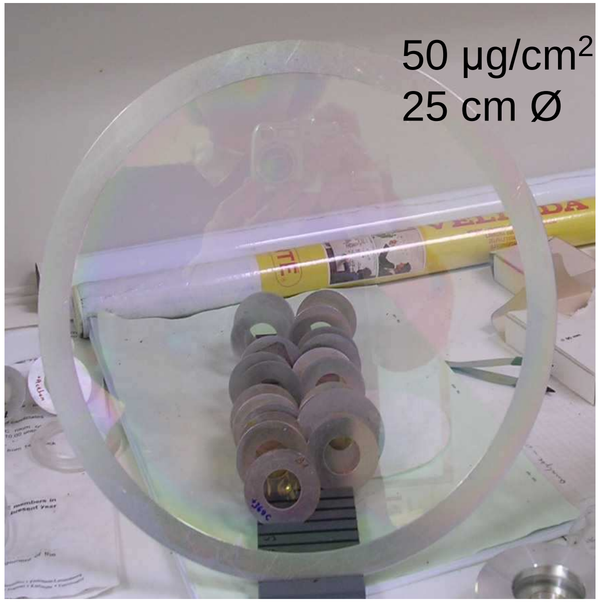
target backings

	Polyimide $(C_{22}H_{10}N_2O_4)_n$	Mylar $(C_{10}H_8O_4)_n$	Aluminium Al
Density	1.41 g/cm^3	1.39 g/cm^3	2.7 g/cm^3
Temp. resist.	> 450- 500 ºC	250 ºC	660 ºC
Min thickn. used	0.21 µm (30 $\mu g/cm^2$)	1.5 µm (200 $\mu g/cm^2$)	2 µm (540 $\mu g/cm^2$)
Min thickn. available	0.07 µm (10 $\mu g/cm^2$)	as above	depends on available technique
resist. to radiation	*see next table*	*???*	



$(C_{22}H_{10}N_2O_4)_n$

excellent mechanical strength
high thermal, chemical and long-term stability
inertness to popular solvents
high resistance to radiation
low dielectric constant



known:

- **Mechanical strength**
  (dropping test with 37 µm/cm² – survived several droppings from 3 m unbroken)

- **life-time of the foil in a beam of charged particle**

- **impurities by PIXE ad RBS**

- **resistance to α radiation**

- **gas permeability – paper in print, NIM A 2008**

Life-time in ……

Polyimide foils of 45 - 47 μg/cm^2

Beam	2.0 MeV ^{4}He – ions			1.5 MeV protons				
beam intensity I (nA)	50	100	160	150	300	500	1000	5000
Beam power $\Delta E \times I$ (W)	4.05×10^{-3}	8.1×10^{-3}	1.3×10^{-2}	1.5×10^{-3}	3.0×10^{-3}	6.0×10^{-3}	1.2×10^{-2}	$6.0x10^{-2}$
Foil status	foil had long life		foil ruptured after 5×10^{-4} C	foil had long life				foil ruptured after $\sim10^{-2}$ C

from M.Jaskóła, A. Korman, A Stolarz , in print NIM A, 2008

Resistance to radiation

- DuPont data for Kapton:
  mixed neutron (flux: $5\ 10^{12}$ n/cm s) and gamma
  $5\ 10^{7}$ Gy - film darkened
  10^{8} Gy - film darkened and harden

- test by J. Pauwels on resistance to α radiation (^{241}Am source): some observations published in NIM 167,1979

tests were performed with polyimide foils prepared by polymerisation conducted in temp. lower than used recently. Increase of polymerisation temp. improved mechanical strength and most probably resistance to radiation too (comparable studies were not done).

$$(C_{22}H_{10}N_2O_4)_n$$

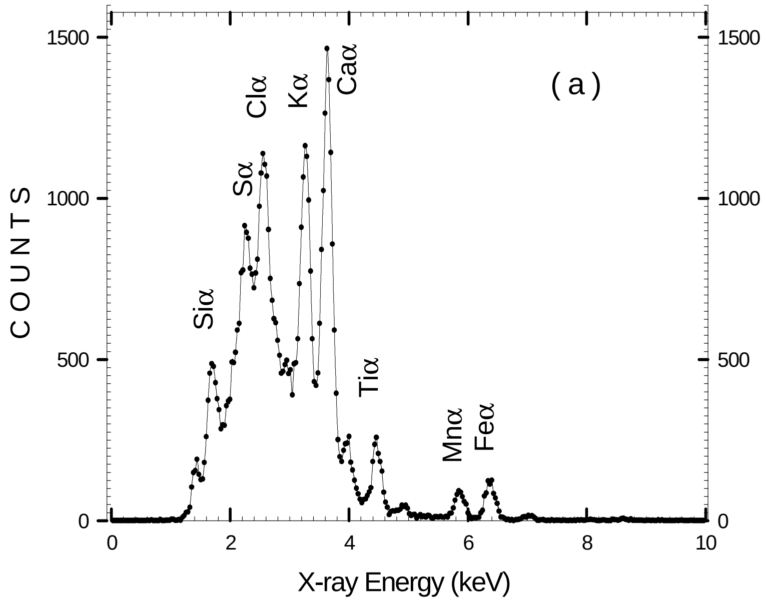
impurities

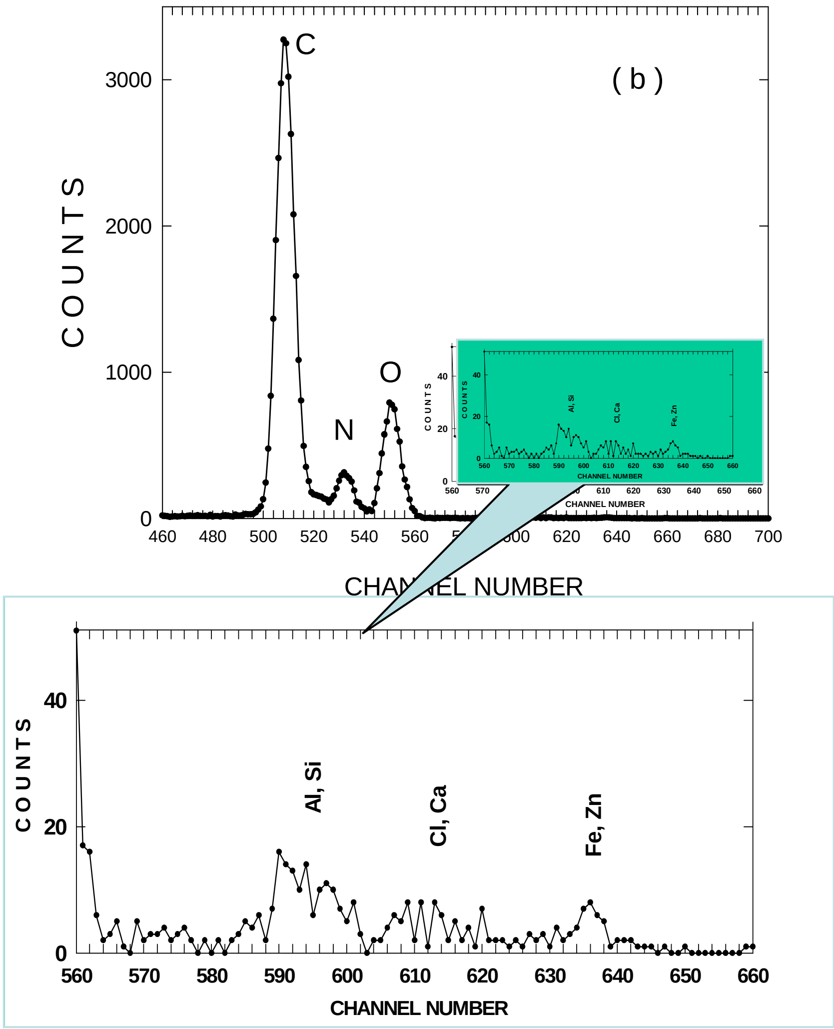
Element	S	Cl	K	Ca	Ti	Mn	Fe
Impurity (ng/cm^2)	14.1 ± 3.1	14.2 ± 3.1	25.3 ± 4.8	48.4 ± 8.7	52.1 ± 12.0	3.9 ± 1.0	41.1 ± 9.5

by PIXE and RBS

from M.Jaskóła, A. Korman, A Stolarz , in print NIM A, 2008

Peaks characteristic for Si, S, Cl, Ca, Ti, Mn and Fe were clearly detected





PIXE spectrum

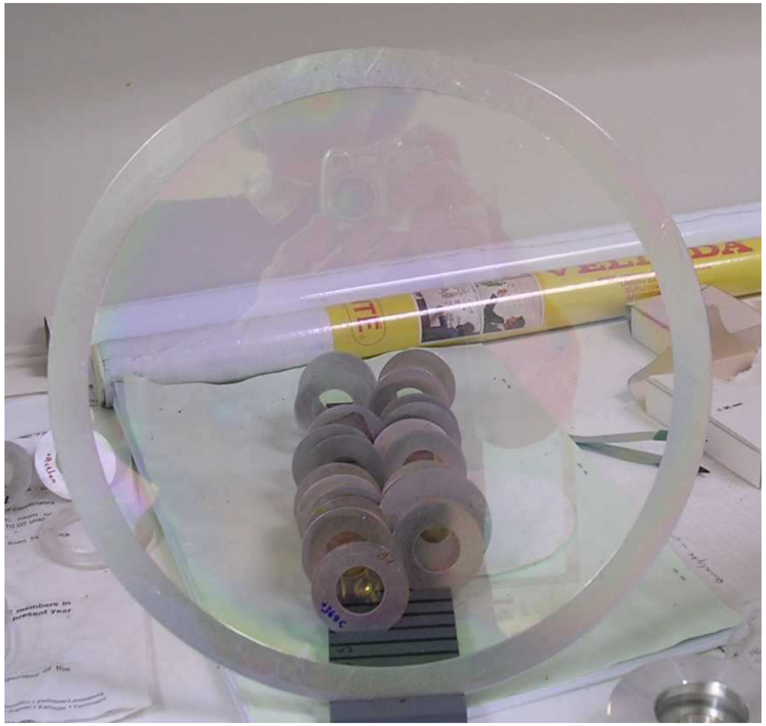
from M.Jaskóła, A. Korman, A Stolarz , in print NIM A, 2008

Permeation rate flow Q and permeability coefficient K for 4 µm *in-situ* and 8.5 µm commercial foils for He and Ar

Input pressure [mbar]	Q [m^3 mbar s^{-1}]	K [m^2 mbar $^{-1}$ s^{-1}]	Input pressure [mbar]	Q [m^3 mbar s^{-1}]	K [m^2 mbar $^{-1}$ s^{-1}]
He - 4 µm *in-situ* foils			**Ar - 4 µm *in-situ* foils**		
4.2	1.55×10^{-8}	$(3.18\pm0.53)\times10^{-15}$	22.7	1.59×10^{-8}	$(6.09\pm0.29)\times10^{-16}$
8.2	3.68×10^{-8}	$(3.87\pm0.64)\times10^{-15}$	45.4	5.83×10^{-8}	$(1.11\pm0.08)\times10^{-15}$
16.2	9.60×10^{-8}	$(5.10\pm 0.84)\times10^{-15}$	62.5	1.05×10^{-7}	$(1.48\pm0.07)\times10^{-15}$
38.2	3.03×10^{-7}	$(6.84\pm 1.12)\times10^{-15}$	101.5	1.69×10^{-7}	$(1.43\pm0.07)\times10^{-15}$
67.0	6.39×10^{-7}	$(8.21\pm 1.39)\times10^{-15}$			
He - 8.5 µm commercial foil			**Ar - 8.5 µm commercial foil**		
4.5	1.42×10^{-9}	$(5.49\pm0.44)\times10^{-16}$	41.6	9.31×10^{-10}	$(4.37\pm0.50)\times10^{-17}$
9.5	3.28×10^{-9}	$(6.01\pm 0.47)\times10^{-16}$	102.7	1.0×10^{-9}	$(1.95\pm0.24)\times10^{-17}$
24	9.11×10^{-9}	$(6.64\pm 0.50)\times10^{-16}$	142.0	1.32×10^{-9}	$(1.80\pm0.25)\times10^{-17}$
55	2.28×10^{-8}	$(7.23\pm0.57)\times10^{-16}$			

K_{He} (literature): $2.24\times10^{-16} – 2.10\times10^{-15}$ m^2 mbar $^{-1}$ s^{-1}
K_{Ar} (literature): $1.27\times10^{-16} – 6.05\times10^{-16}$ m^2 mbar $^{-1}$ s^{-1}

from A. Stolarz, M.Varlam, R. Wellum; in print, NIM A 2008



The applied method allows preparation of self-supported foils with diameter of 25 cm and thicknesses down to 25 μg/cm^2

Foils as thin as **11 μg/cm^2** were polymerized and floated as well but it was difficult to mount them on the frames with apertures diameter greater then 10 cm.

from A. Stolarz, J.Van Gestel, NIM A 561 (2006) 115