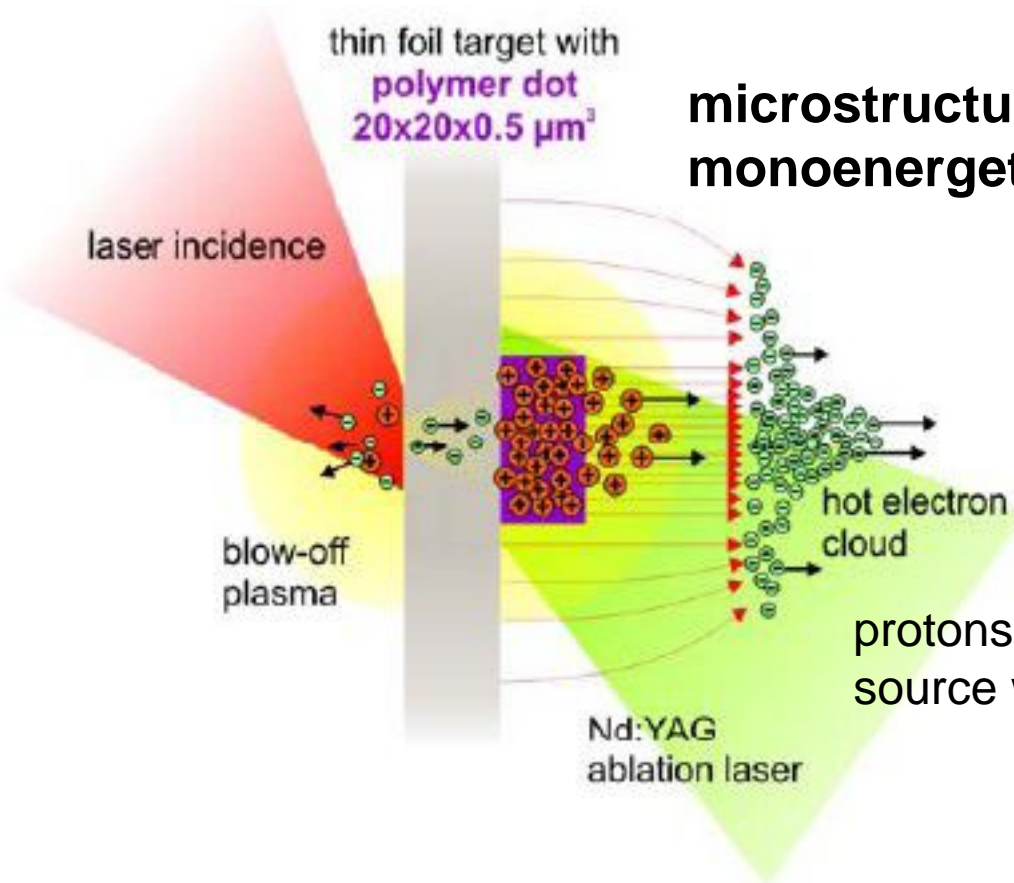


Sven Herzer

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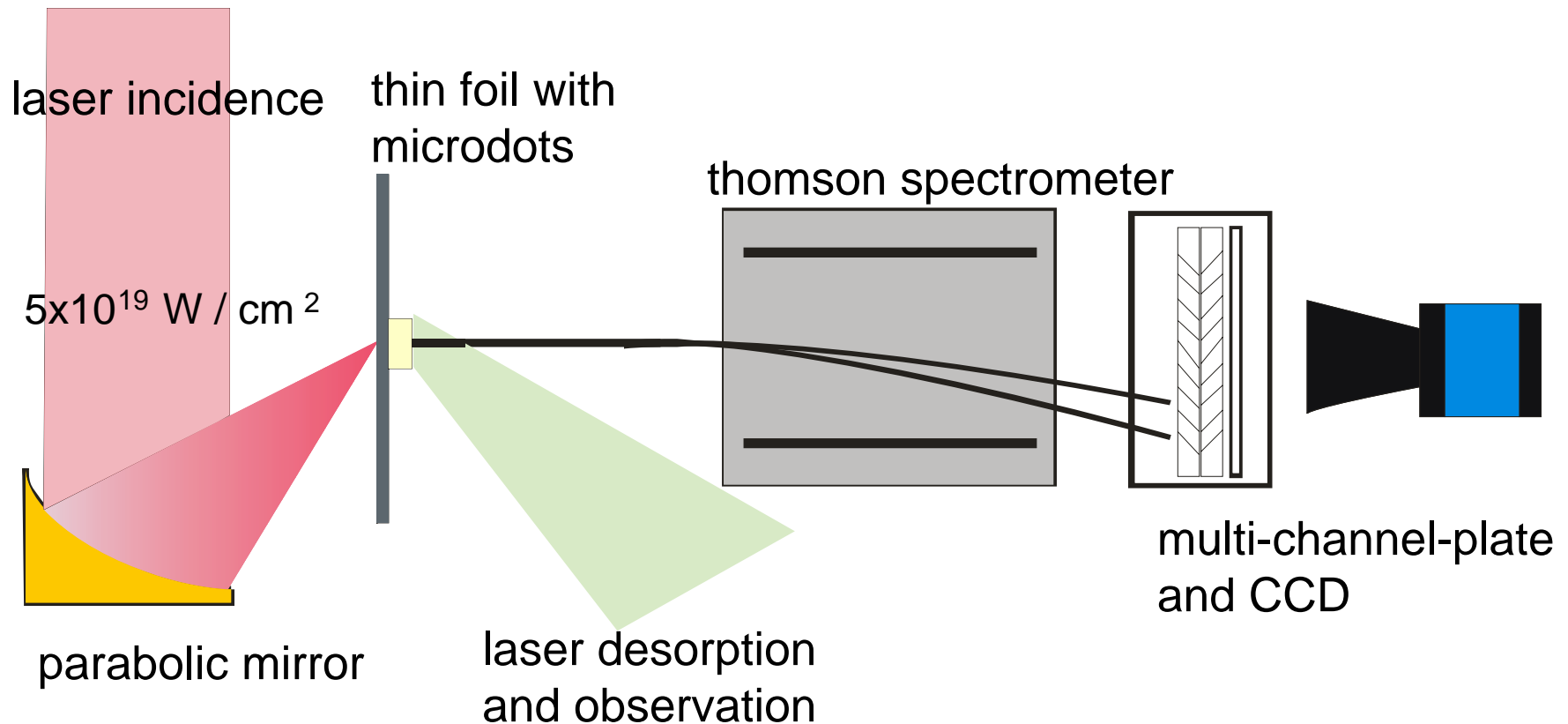
microstructured targets for producing monoenergetic proton beams

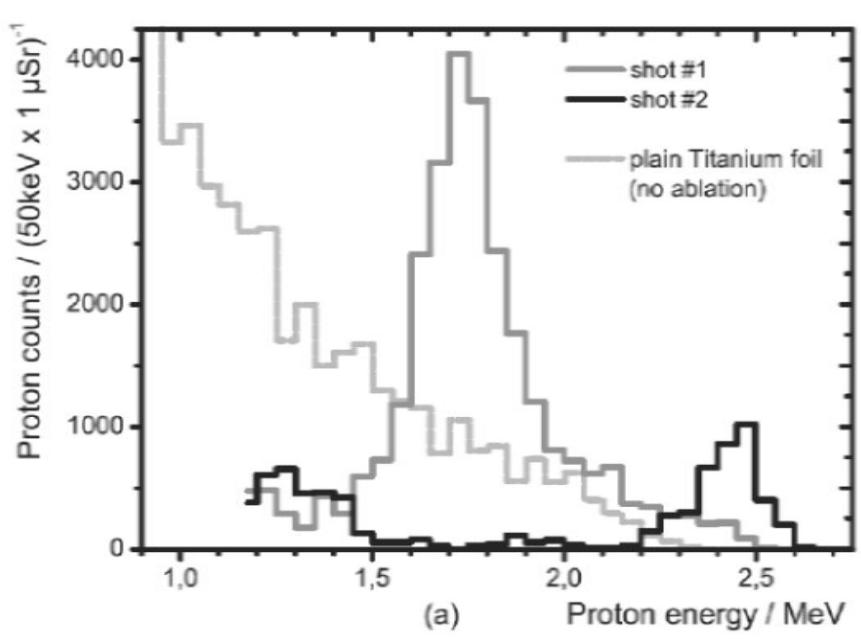


protons are radially confined to a dot source within the central field region

[1] Esirkepov TZ *et al* 2002 Proposed double layer target for the generation of high-quality laser-accelerated ion beams *Phys.Rev.Lett.* **89** 175003

JETI: 10TW titanium:sapphire laser system in Jena
1.3J, 80fs, 10Hz repetition rate





- proton beams with 1.2 – 2.2 MeV central energy
- 10 percent energy spread
- more than 10^9 protons per laser shot

[2] Schwoerer *et al* 2006 Laser-plasma acceleration of quasi-monoenergetic protons from Microstructured targets *Nature* **439** 445-8

[3] Pfothenauer *et al* 2008 Spectral shaping of laser generated proton beams *New Journal of Physics* **10** 033034

Structuring via laser ablation:

- mask projection technique (excimer laser)
- direct writing (short pulse laser)

Several microns thick titanium foil

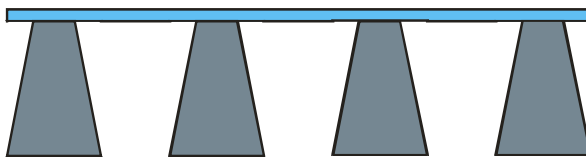


spin-coated PMMA layer, dispensable polymer ablated by laser

Structuring via photolithography:



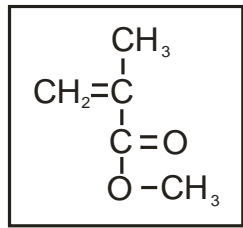
5 micron thick nickel foil with polymer dots fabricated by contact printing lithography



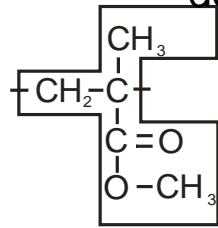
80 nano-meters chrome membrane on silicon wafer with channels for laser incidence produced by etching

Polymethacrylat (PMMA) applied on 5 μ m titan foil by spincoating

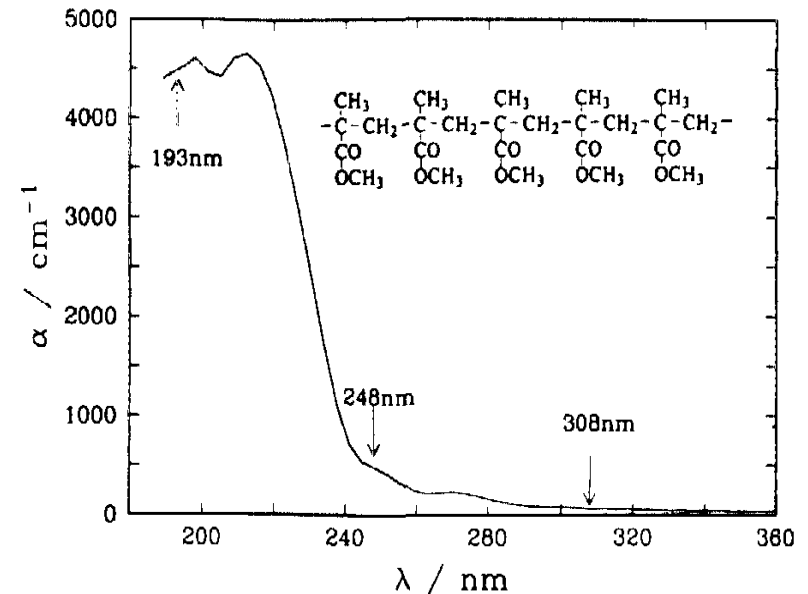
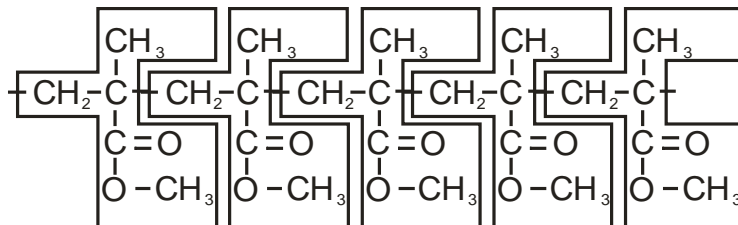
Monomer



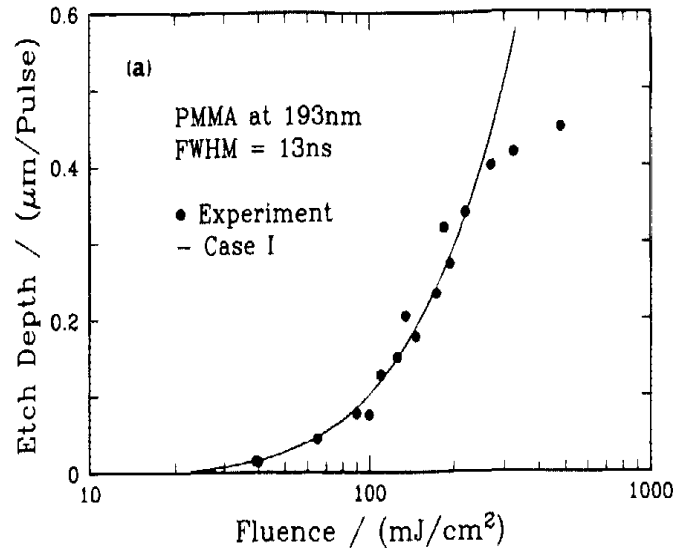
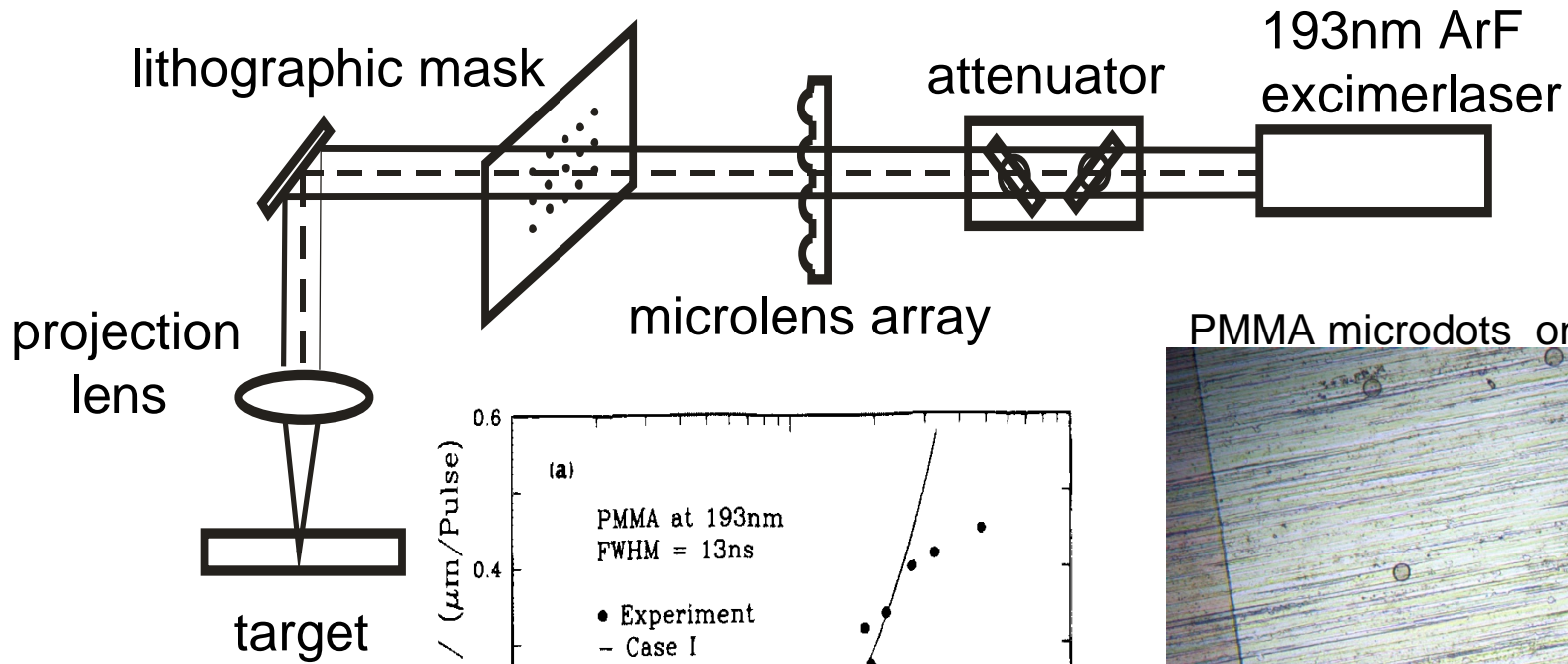
Polymerization by breaking the double bond



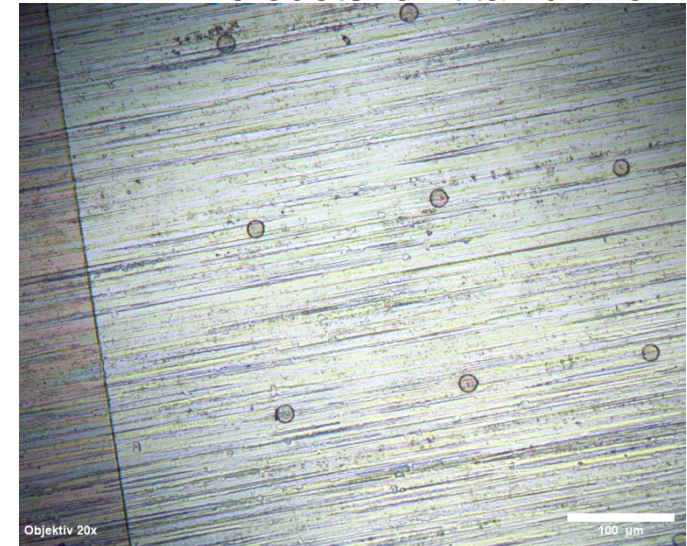
Polymer chain



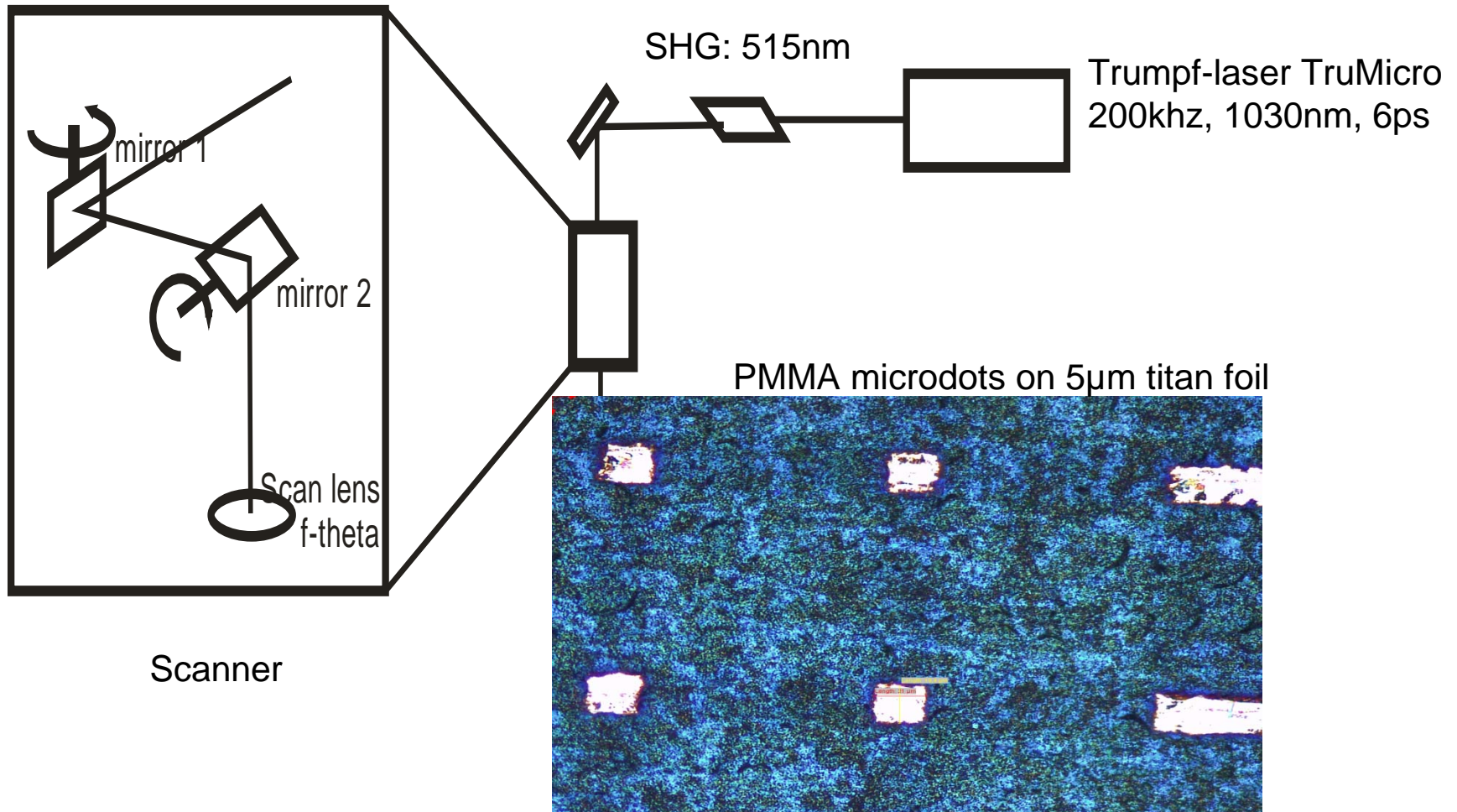
[4] Sutcliffe *et al* 1986 Dynamics of UV laser ablation of organic polymer surfaces
J.Appl.Phys. **60** (9)



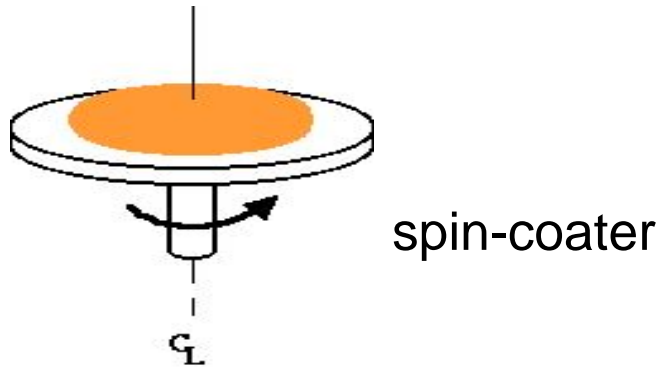
PMMA microdots on titanium foil



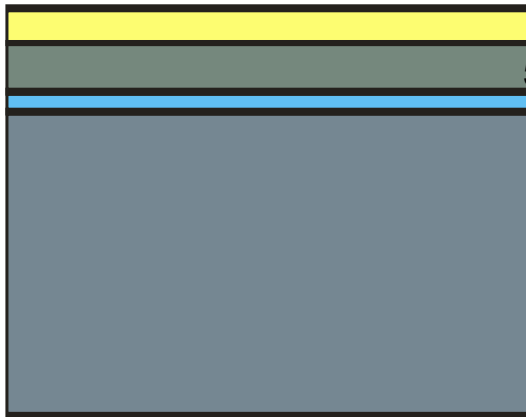
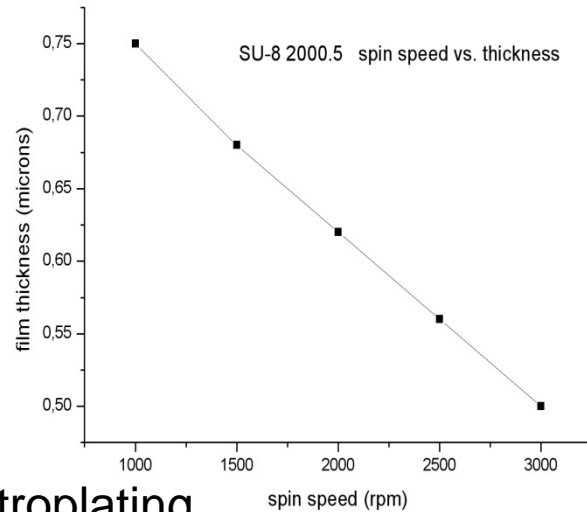
Microstructuring through direct focusing:



SU-8 (negative photoresist) as proton source applied on 5 μ m nickel by spincoating



covering the nickel layer with 500nm SU-8 by spin-coating technique

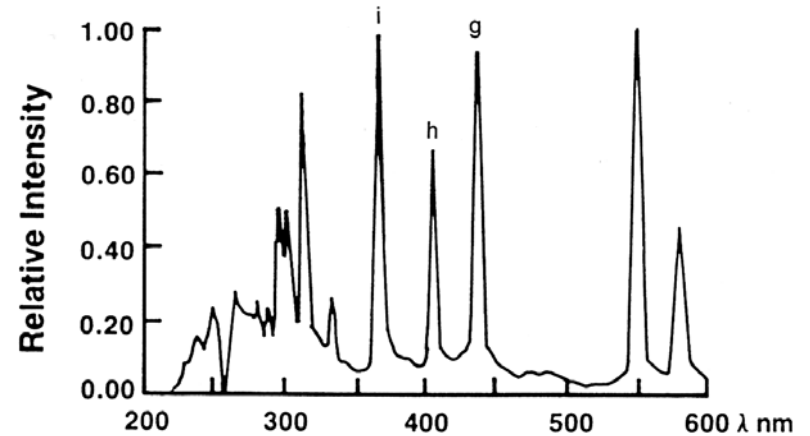
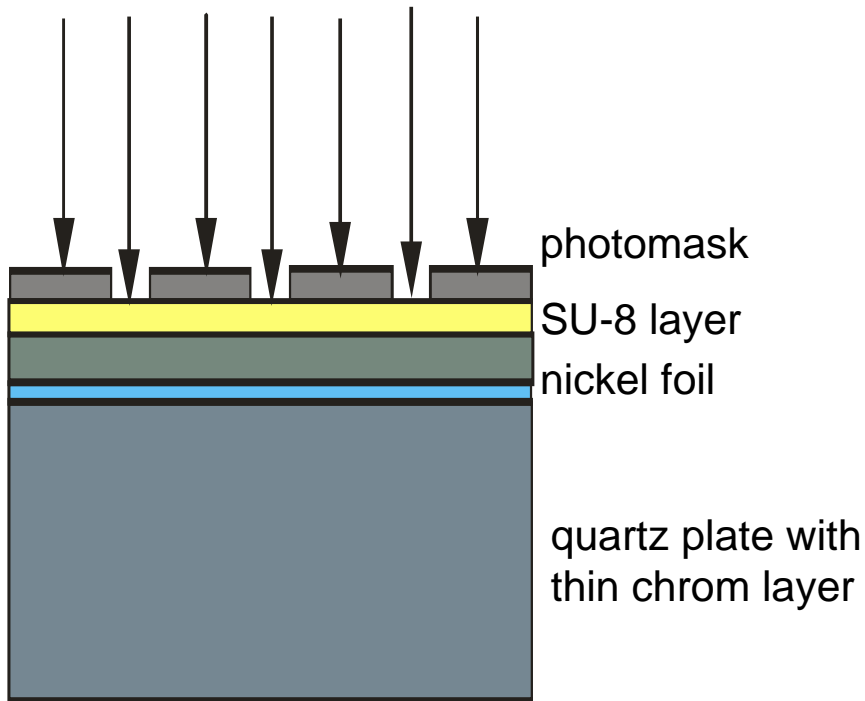


5 microns nickel by electroplating

4" quartz mask blank carried with a thin chrome layer by sputtering technique

contact printing:

exposure parts of the polymer-layer
with a conventional uv source:
350...405nm



spectral distribution of a mercury
discharge

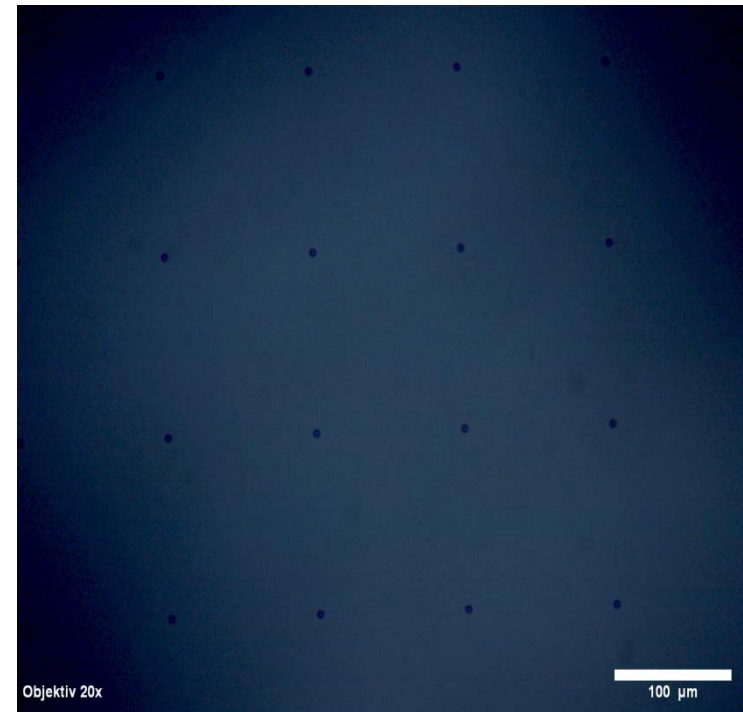
photomask



SU-8 microdots on 5 μ m nickel foil

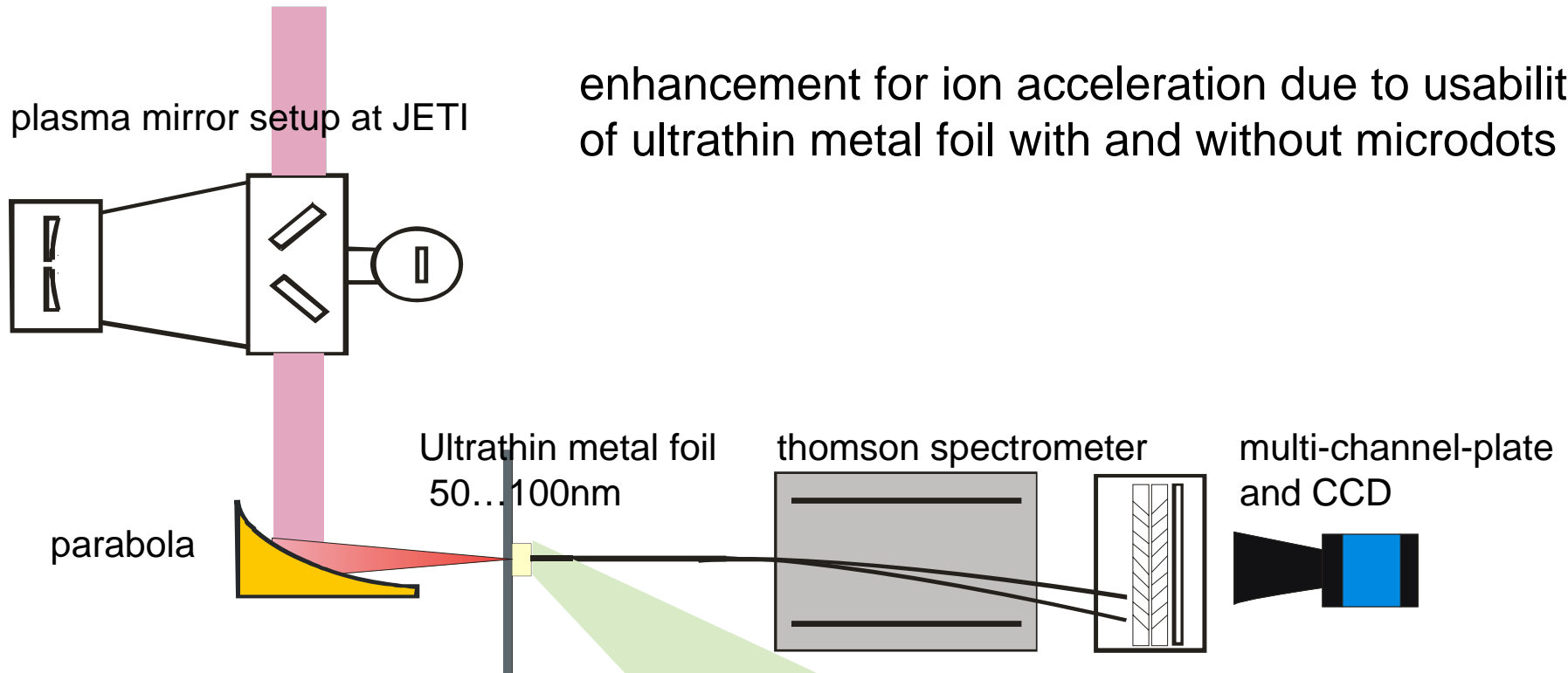


quartz plate (reusable)



micrograph of microdots on foil

enhancement for ion acceleration due to usability of ultrathin metal foil with and without microdots



[5] Antici *et al* 2007 Energetic protons generated by ultrahigh contrast laser pulses interacting with Ultrathin targets *Physics of Plasmas* **14** (030701)

[6] Neely *et al* 2006 Enhanced proton beams from ultrathin targets driven by high contrast laser pulses *Appl.Phys.Lett.* **89** 021502

[7] Ch. Rödel, Friedrich Schiller Universität Jena, Diploma thesis

4" Silicon-Wafer, thickness 525microns



80 nanometers Chrome to wafer backside by sputtering technique



positive photoresist is spincoated to wafer frontside



exposure the resist by intense pattern of light



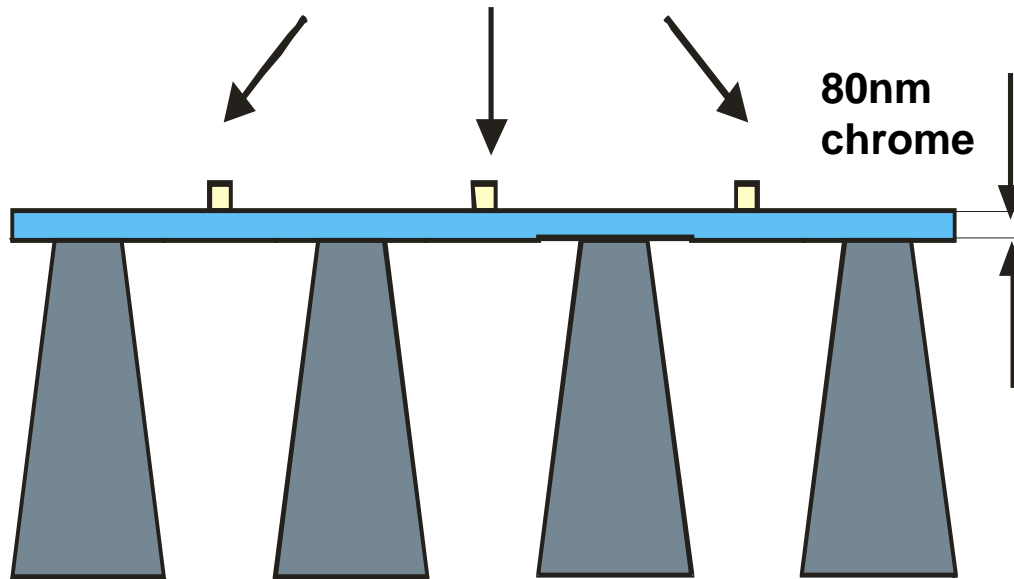
unwanted parts of the resist are removed by developer



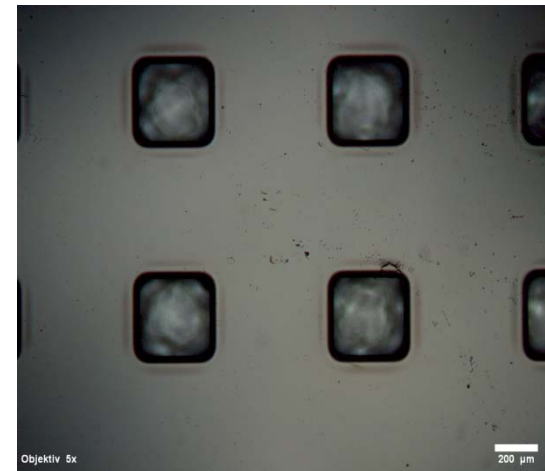
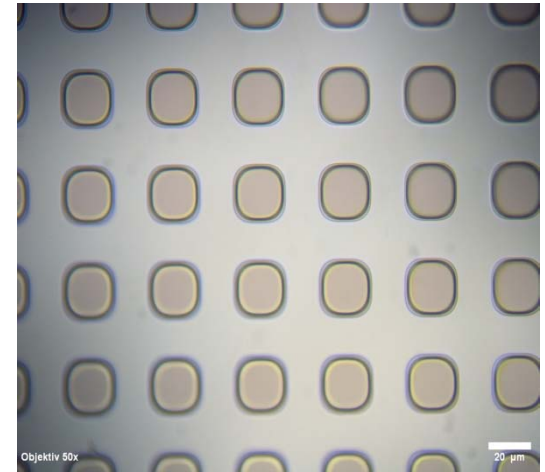
wet etching process and strip the photo resist

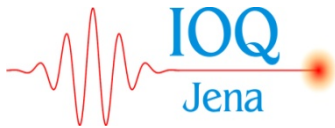


applying microdots at the ultrathin chrome layer at backside of wafer is possible too



channels for the laser pulse incidence
fabricated by a wet etching process





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