Introduction to Micropatterning and Microstructuring 1

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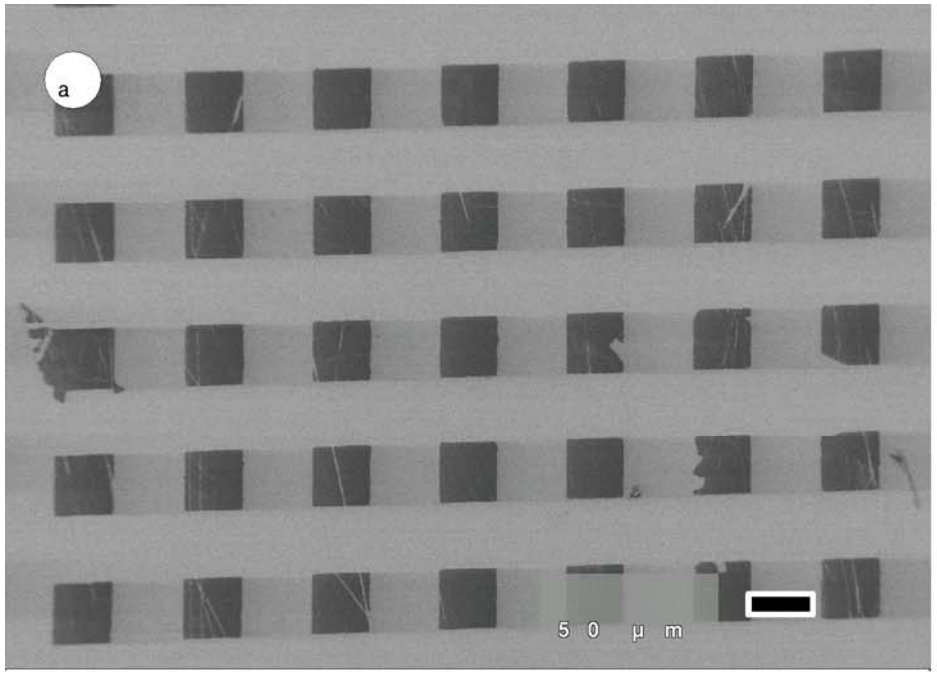
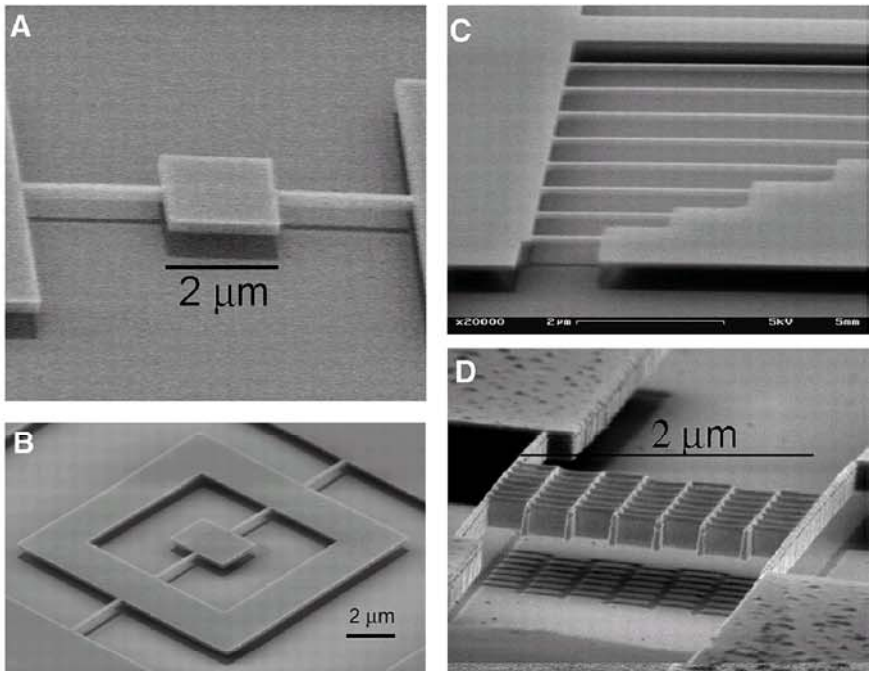
- What is "**Micropatterning**" and "**Microstructuring**" ?

⇒ 2D and 3D structuring of a surface / substrate in micro– and nanometer dimensions



Low voltage SEM of OTE monolayer with square holes on Si substrate



SEM of different nanoelectromechanical systems (NEMS)

Introduction to Micropatterning and Microstructuring 2

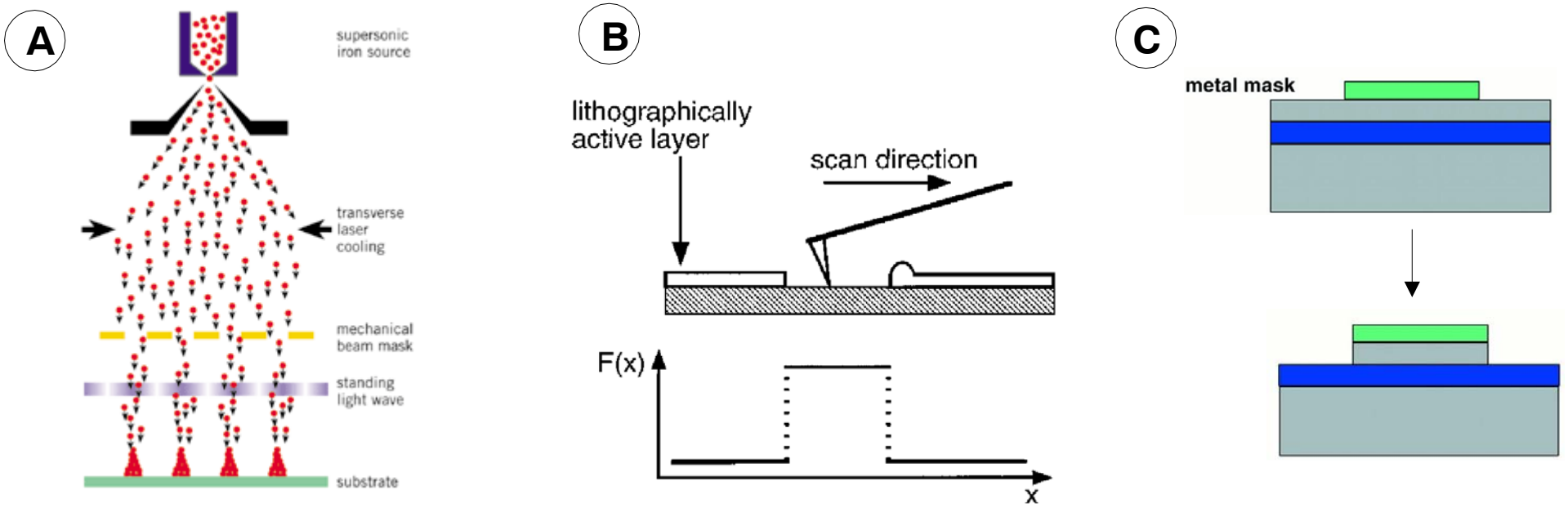
- How is it **done** ?

  ⇒ controlled deposition of material:

  – through a mask > parallel process **A**

  – in a "plotting" fashion > sequential process **B**

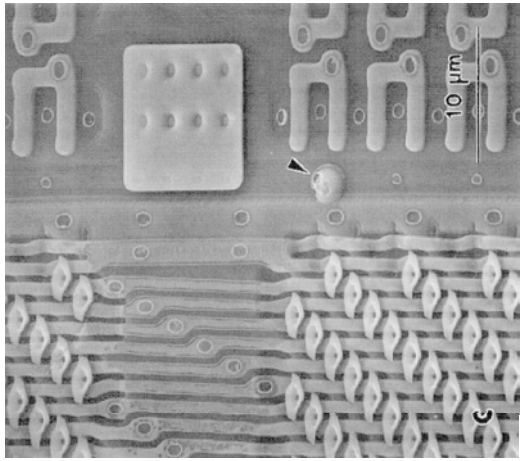
  ⇒ etching of the substrate at predefined areas determined by a resist **C**



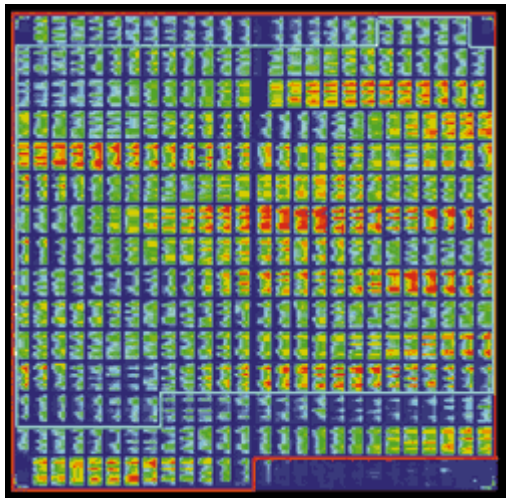
Introduction to Micropatterning and Microstructuring 3

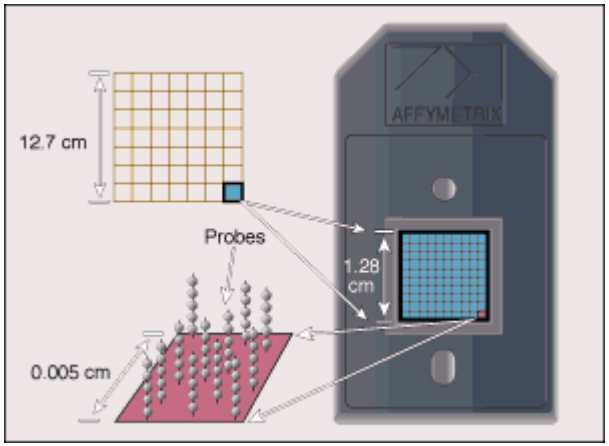
- What is it **good for** ?

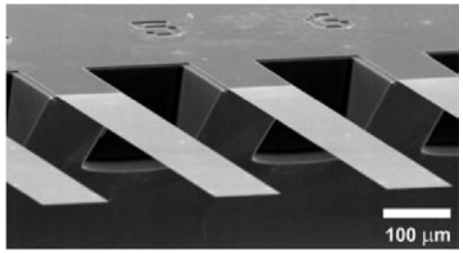
⇒ predominant in microelectronics / chip fabrication

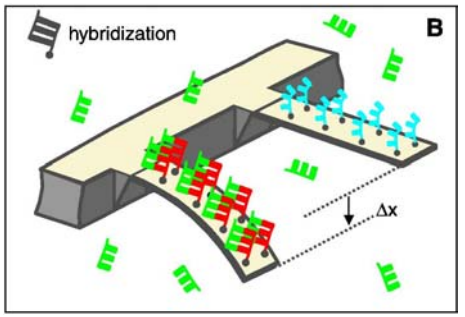


⇒ new fields are emerging: DNA diagnostic chips, biosensors, e.g.



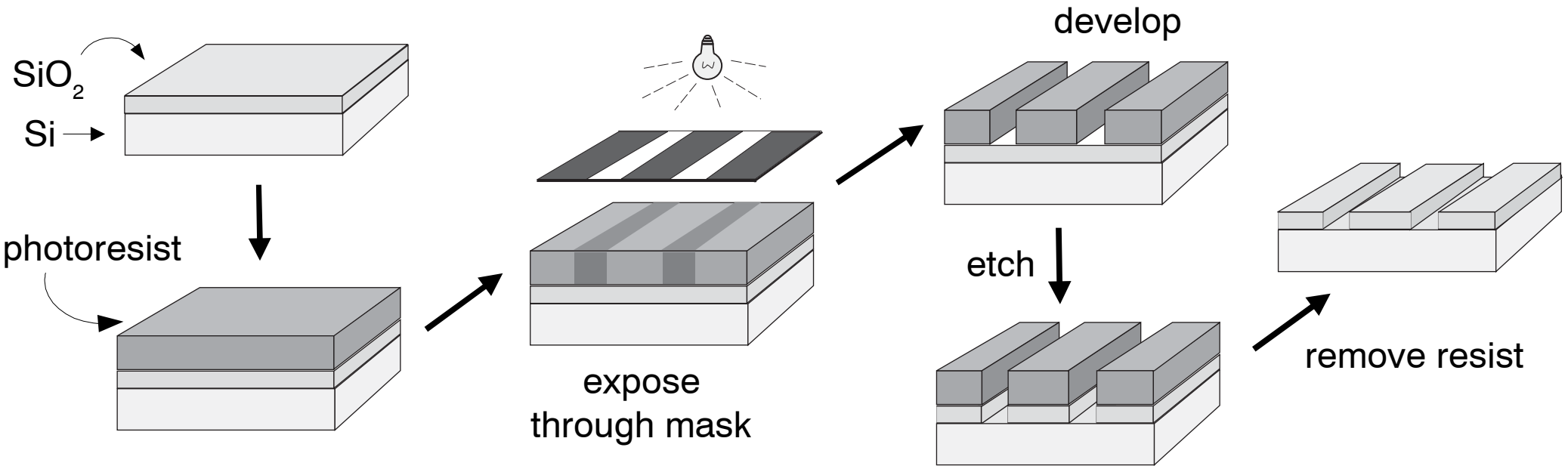




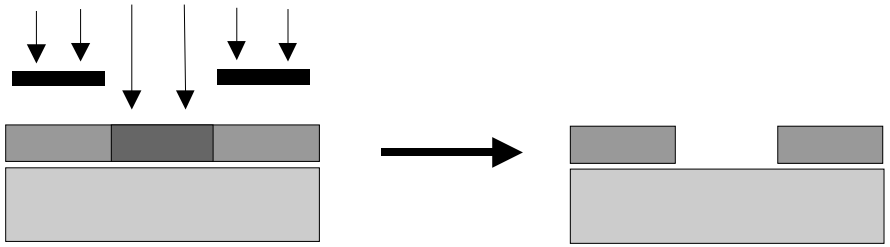


Photolithography 1

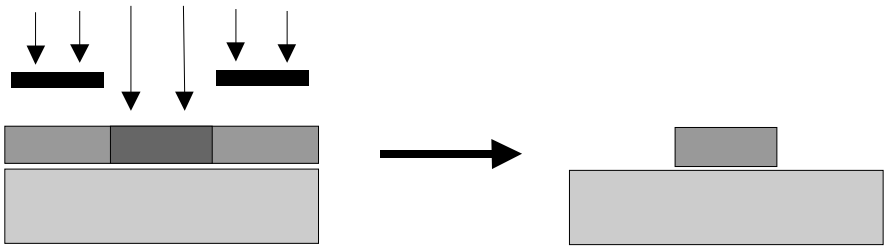
- **Spin coating** of a substrate with a **photosensitive polymer** layer as **mask** material for deposition or etching process, **exposure**, and **development**:



⇒ **positive resist**: exposed areas are dissolved



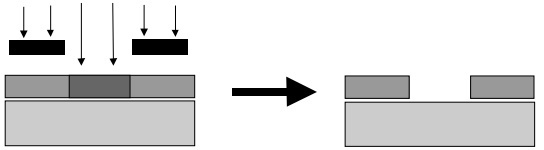
⇒ **negative resist**: exposed areas remain

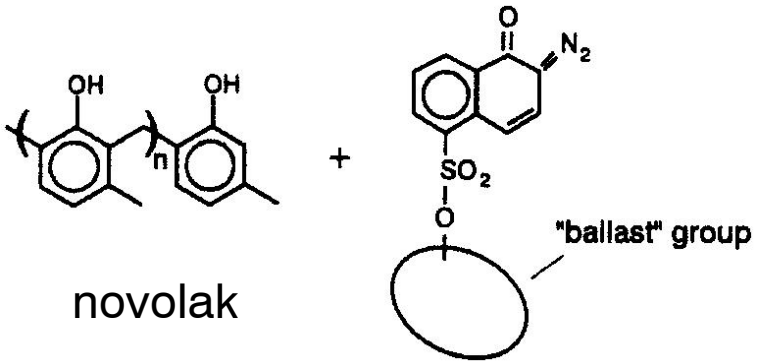


Photolithography 2

- **Chemical examples** of positive– and negative–tone **photoresists**:

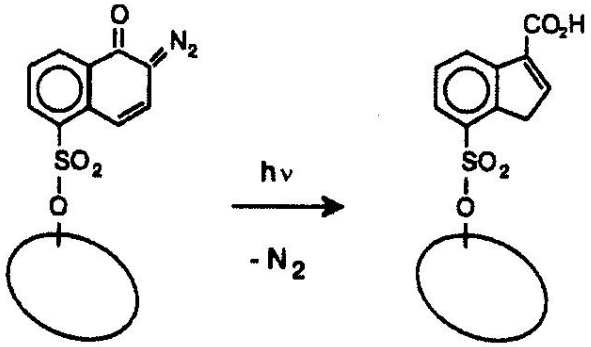
⇒ **positive–tone resist**: exposed areas are dissolved





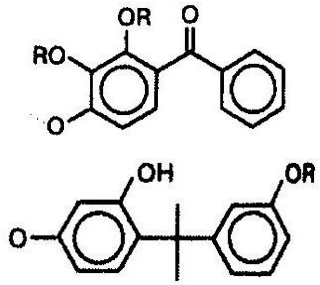
novolak

DNQ



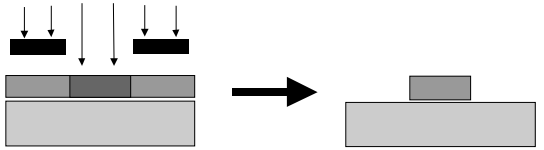
base soluble

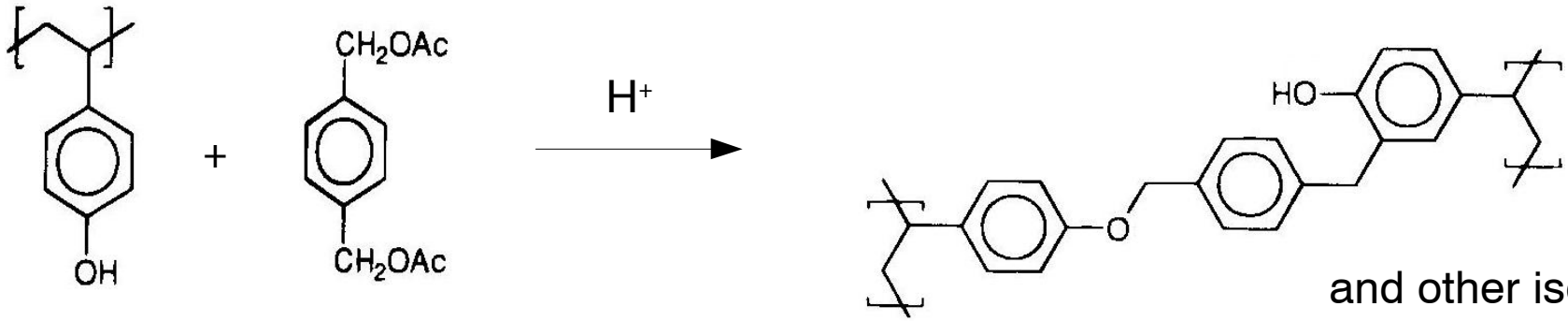
ballast groups:



R = H or DNQ

⇒ **negative–tone resist**: exposed areas remain after development

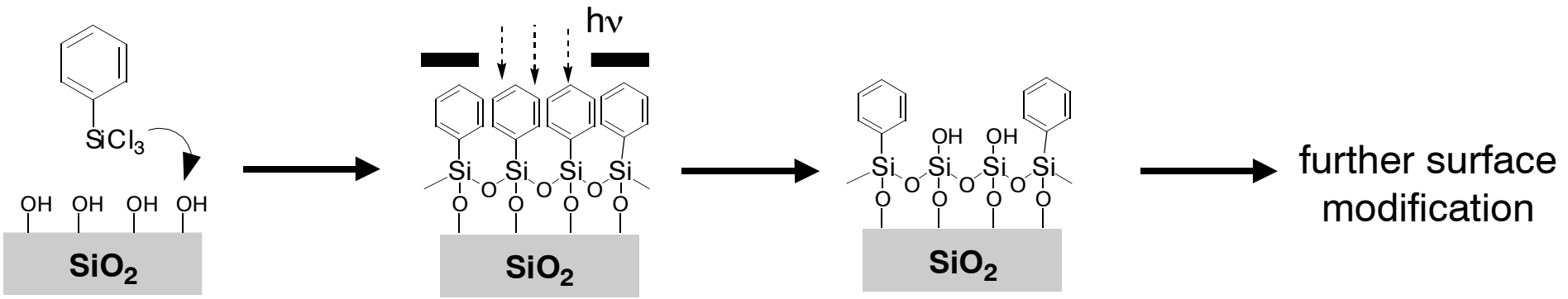




and other isomers

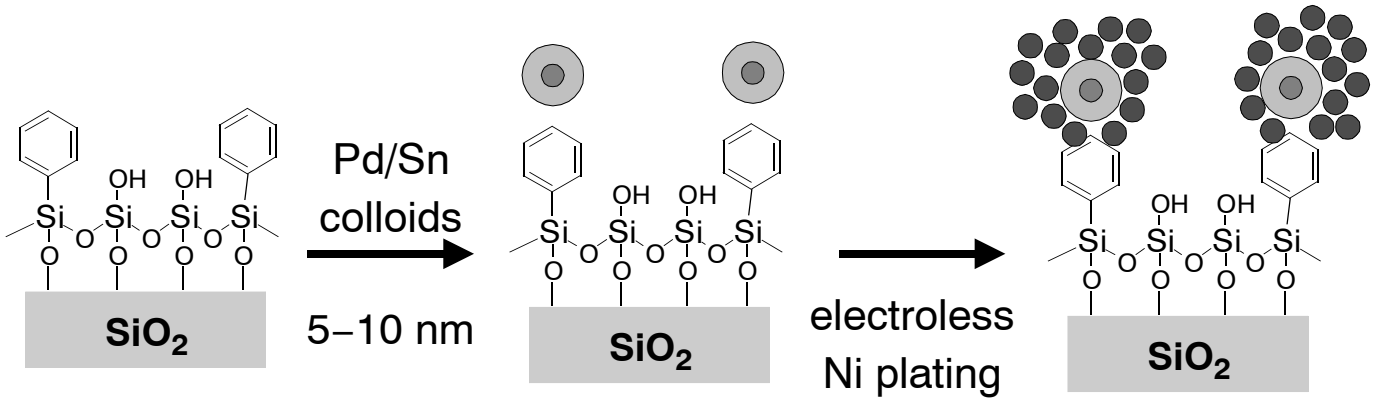
Monolayer Photolithography

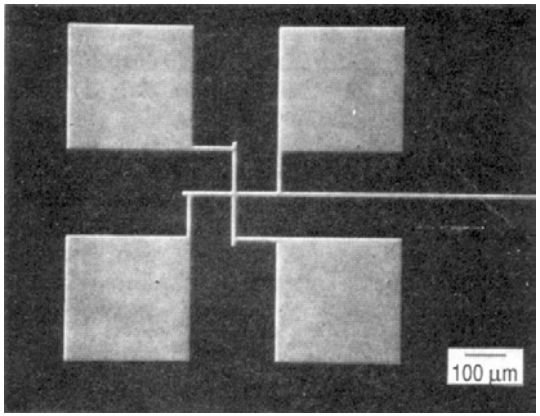
- **Direct patterning** of **organic monolayer** by **deep UV** (DUV) irradiation through mask:



Lit.: Calvert et al., *Science* **1991**, *252*, 551–554

⇒ **electroless metallization** selectively on the **organic surface** modified with **Pd/Sn catalyst**

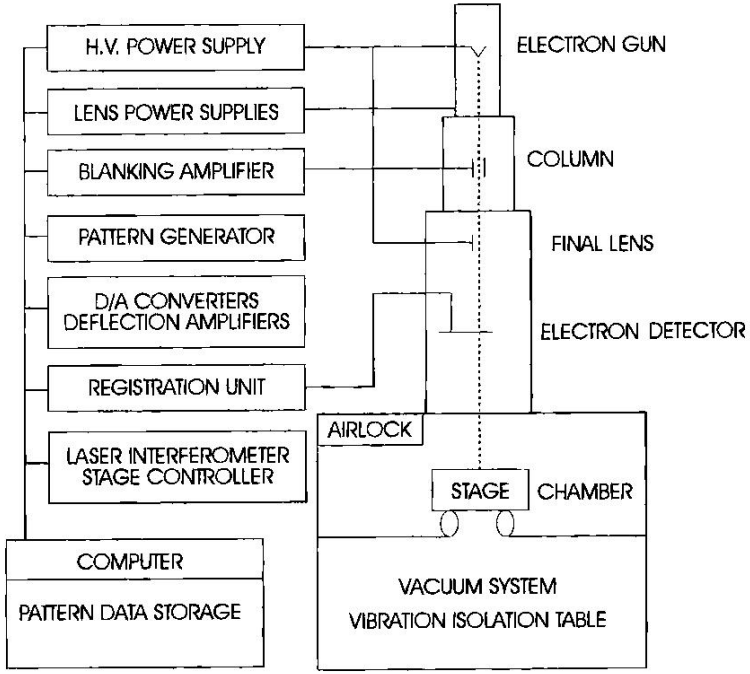




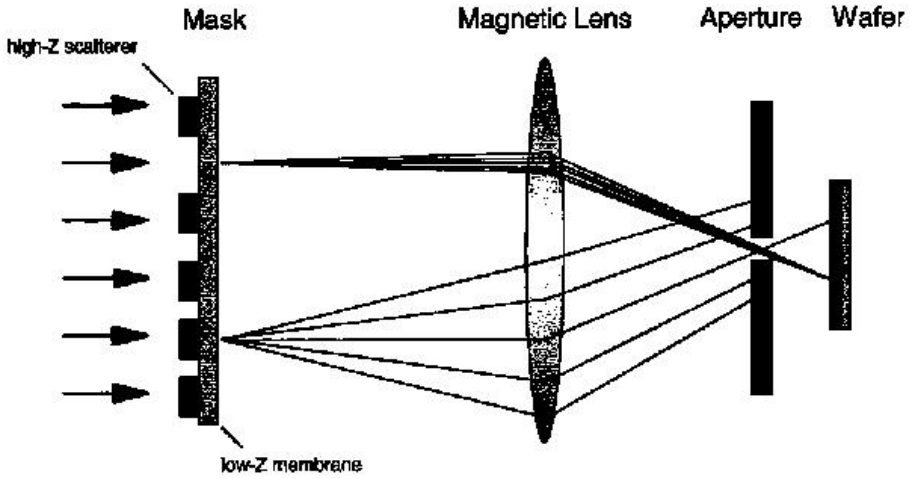
Electron–Beam Lithography

- **Electrons** are used instead of light to **expose** the **resist** material:

⇒ **sequential** exposure by beam **scanning**:



⇒ **parallel** exposure through **mask**:



SCALPEL

⇒ **materials** for e–beam resists:

– PMMA

– poly(butene–1–sulfon):