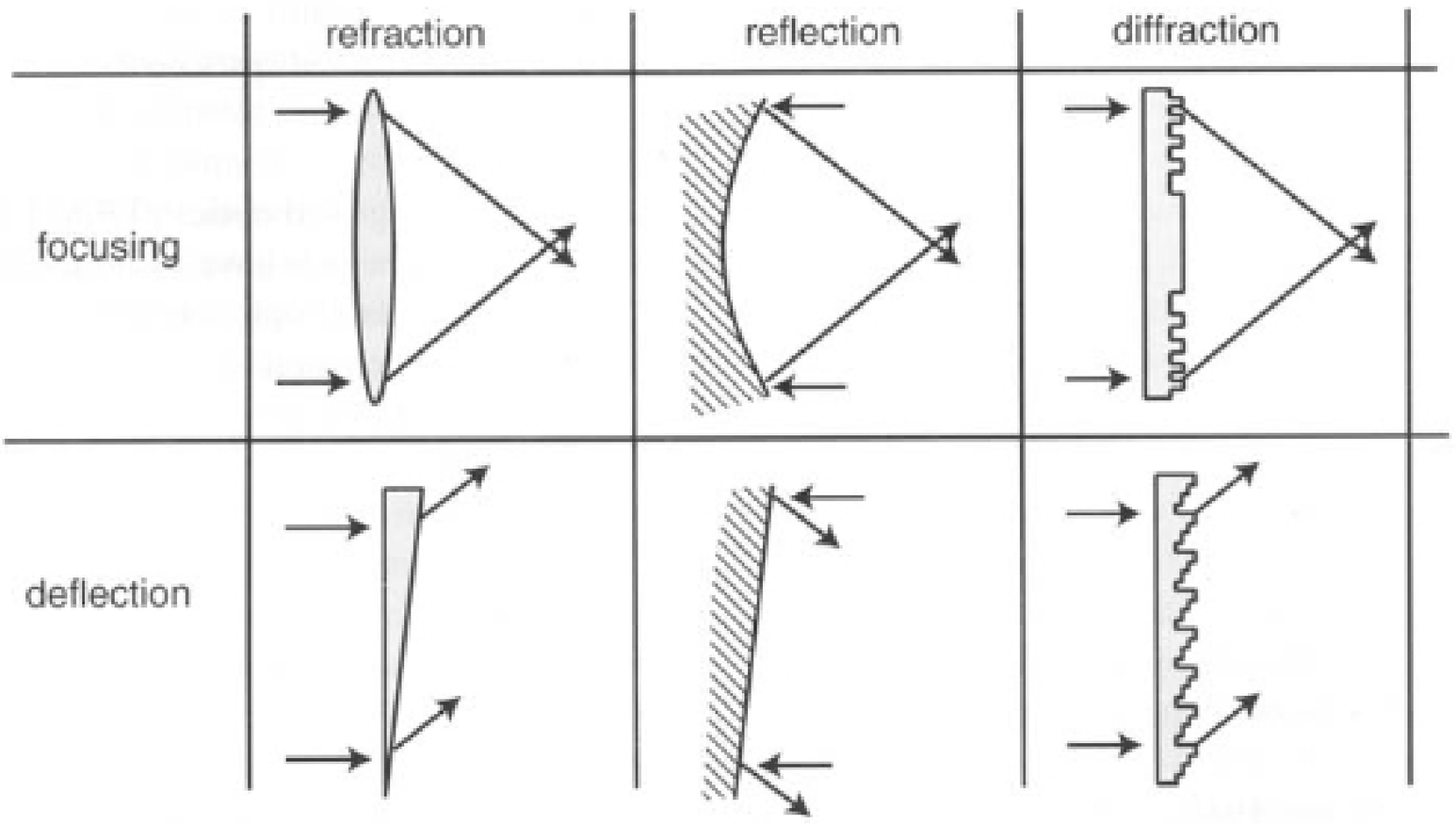
Lecture 22
Optical MEMS (4)

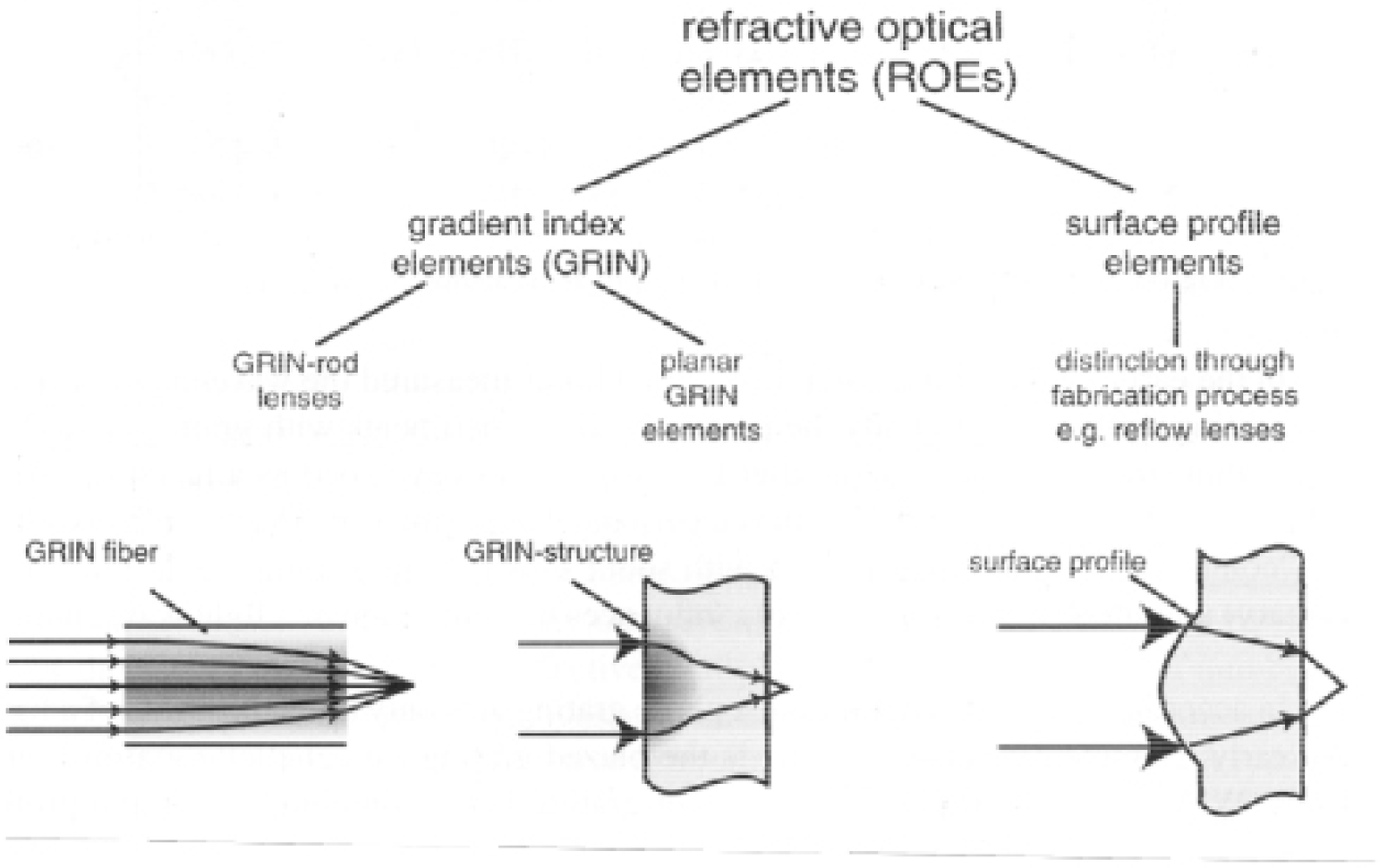
- Agenda:
  - ↗ Refractive Optical Elements
    - Microlenses
    - GRIN Lenses
    - Microprisms

Reference: S. Sinzinger and J. Jahns, Chapter 5 in *Microoptics*, Wiley-VCH, 2003

Optical Functions and Their Implementation



Classification of Refractive Optical Elements

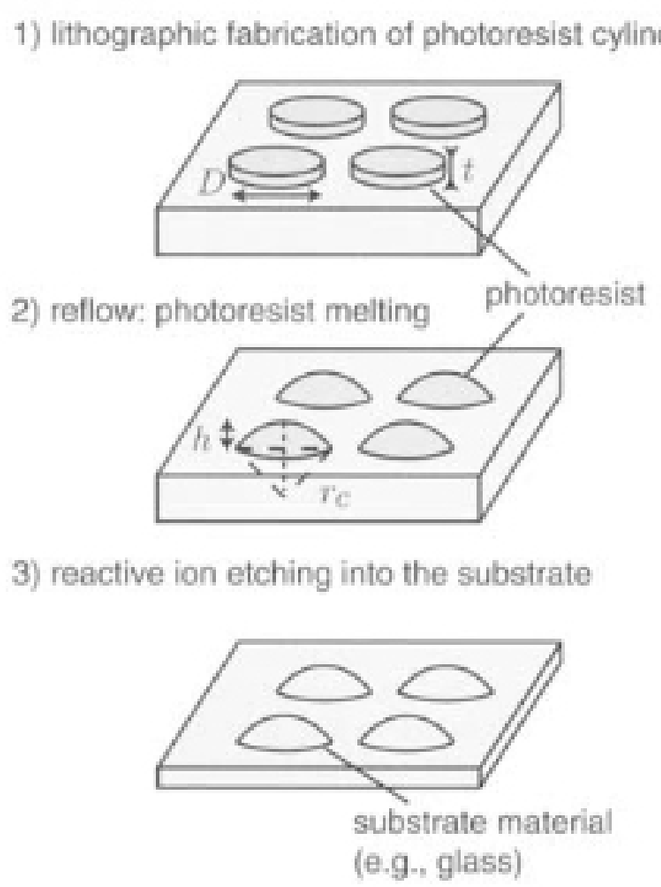


Refractive Micro-Optics

- **Surface Profile Microlenses**
  - Melted photoresist lenses – reflow lenses
  - Mass transport
  - Volume change
  - Lithographically initiated volume growth
  - Dispensed or droplet microlenses
  - Direct writing
  - Grey-scale lithography
- **Gradient-index (GRIN) Optics**
  - GRIN rod lenses
  - Planar GRIN lenses
- **Microprisms**

1. Surface Profile Microlenses

1.1 Melted Photoresist Lenses – Reflow Lenses



1.1 Photoresist Reflow Microlenses

Focal length

$$f = \frac{r_c}{n-1}$$

r_c: radius of curvature of the spherical lens
n: refractive index of the lens material. n~1.4-1.6 for most polymers.

Photoresist volumes before and after photoresist reflow:

$$V_{cyl} = \pi\left(\frac{D}{2}\right)^2 t$$

$$V_{sph} = \pi h^2 \left(r_c - h/3\right)$$