1 Introduction

Highlights of this chapter: Motivation of nanooptics and nanophotonics

Traditionally optics is a subfield in fundamental as well as in applied sciences. Nanooptics has emerged from the wider area of nanoscience. Although terminology is not strict one can refer to *nanooptics* addressing more fundamental aspects and *nanophotonics* addressing more applied aspects, respectively.

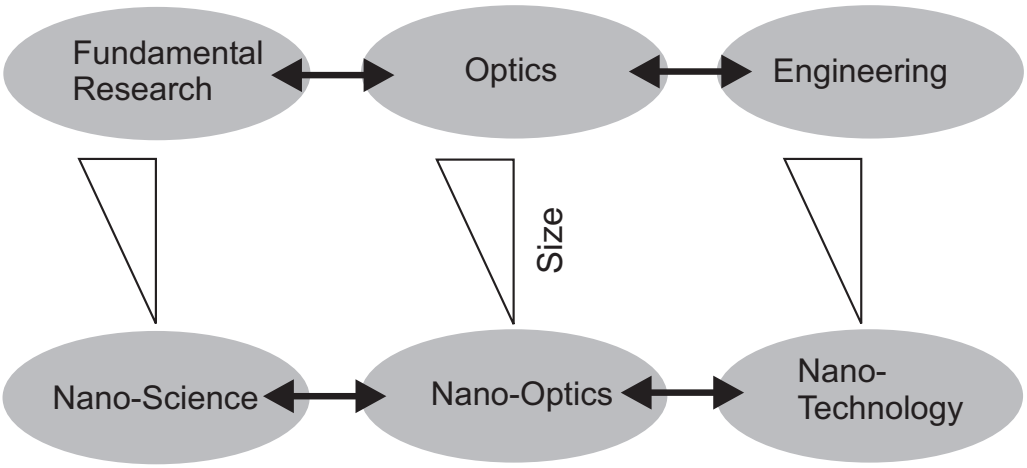

Figure 1: Relation between (nano)sciences and (nano)technologies.

Modern optics provides extremely powerful tools. Optical methods are precise (relative precision $< 10^{-17}$) and allow to investigate dynamics on shortest time-scales (attoseconds).
Several problems and questions addressed by nanooptics are:

- How to obtain information about structure and functionality on a length scale far below several 100 nanometers with optical methods?
- Is the interaction (both classically and quantum mechanically) of light and matter fully understood on any length scale?
- How far-reaching is optics or an "optical" description of phenomena?

There is extensive literature on the history of optics in general, which shall not be repeated here.

Often (but not always) progress in optics was driven by technological progress:

Remark:
The idea for scanning near-field optical microscopy (SNOM) was formulated by Synge already in 1928. However, a technological problem, i.e., scanning of a tiny probe with nanometer precision was not possible at that time. Thus, the idea was given up as too challenging.
A new independet suggestion of the SNOM method came by O'Keefe in 1956. First experimental demonstrations with microwaves were demonstrated by Ask and Nichols and showed optical resolution of $\lambda/10$.
Finally, break-through experiments in the truely optical (visible) regime were performed by Pohl et al. in the early 80s.

There are numerous areas where methods of nanoopics and nanophotonics are applied today. The following graph gives an overview over several examples.

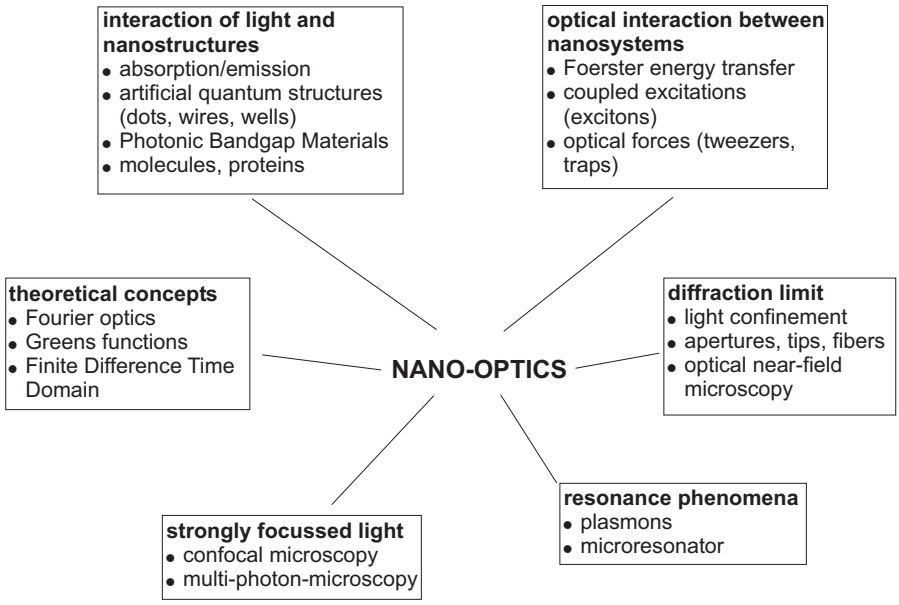

Figure 2: Topics in nanooptics and nanophotonics [inspired from Novotny and Hecht, "Principles of Nano-Optics"].