

# Solid State Optics

Lukas Hein, Elias Schwarzkopf

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Versuchsdurchführung: ?? . ?????

Protokollabgabe: ?? ??

## 1 Introduction

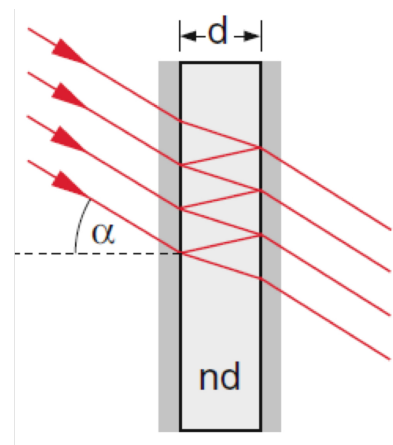
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## 2 theory

### 2.1 Plane parallel layer

The investigated semiconductor samples can in first approximation be described as a plane parallel layer 1 with a thickness  $d$  and refractive index  $N_2$  which acts like a fabry-perot interferometer. Light is simplified



**Abbildung 1:** Simplified illustration of the measured samples as a plane parallel plate with thickness  $d$  and refractive index  $N_2$ . The surrounding air is described with a refractive index  $N_1 \approx 1$  [1]

as beams. Every incoming beam is partially reflected and partially transmitted at the first interface. The total power reflectivity  $R_1$  is described with:

$$R_1 = \left| \frac{1 - N_2}{1 + N_2} \right|^2 \quad (1)$$

without considering the phase shift of the reflected beam. Like shown in the illustration, the total power reflectivity of the second interface  $R_2$  consists of the incoming beams and the beams reflected at the first interface within the material. Additionally, the absorption of the material is considered. Therefore,  $R_2$

is described with:

$$R_2 = R_1(1 - R_1)^2 \cdot e^{-2\beta d} \quad (2)$$

with the absorption coefficient  $\beta$  and the total power reflectivity  $R_1$  of the first interface. The assumption that the reflection of the first interface is the same as the reflection of the second interface is in reality not correct. Disturbances like roughness of the interfaces or the absorption of the material lead to a different reflection coefficients of the two interfaces. Considering this and the phase of the light, the total power reflectivity  $R$  is described with:

$$R = \left| \frac{(e^{i\frac{2\omega}{c}N_2d} - 1)(1 - N_2)}{e^{i\frac{2\omega}{c}N_2d}(1 - N_2) - (1 + N_2)} \right|^2. \quad (3)$$

### 3 Set-Up

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### 4 Bibliography

#### Literatur

- [1] Meschede D., *Gerthsen Physik*, Springer Verlag, 25th Edition, 2018. Modified by Lukas Hein and Elias Schwarzkopf.