

## Optics

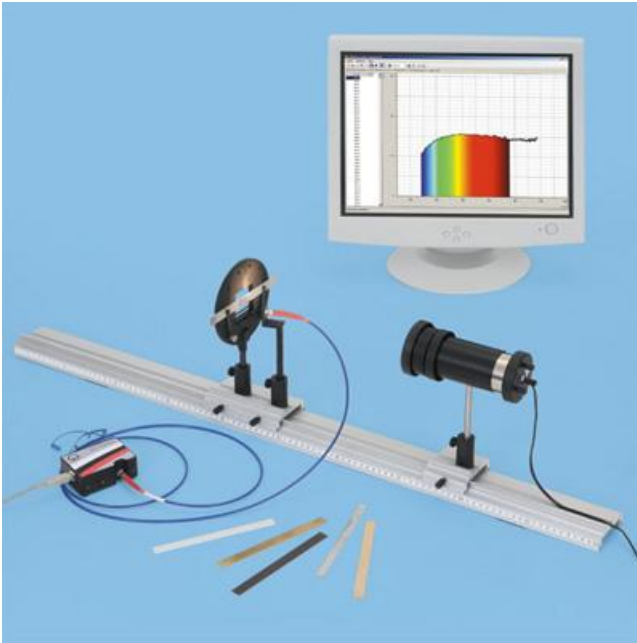
Dispersion and chromatics  
*Reflection spectra*

Reflection spectra of  
different materials -  
Recording and evaluating  
with a spectrophotometer

### Description from SpectraLab (467 250)

For loading examples,  
please use the SpectraLab help.

## Reflection spectra of different materials



### Experiment description

Our impression of the colour of opaque objects arises from the part of the colour spectrum those objects reflect.

In this experiment, the light from an incandescent lamp is analysed using a spectrometer after reflection by various materials. By comparison with the reflection from a sheet of white paper (scattered light), the reflection coefficient can be calculated.

### Required equipment





1	Compact spectrometer, physics	467 251
1	Fibre holder	460 251
1	Lamp housing with cable	450 60
1	Bulb, 6 V/30 W, E14, set of 2	450 511
1	Condenser with diaphragm holder	460 20
1	Transformer, 6/12 V	521 210
1	Holder with spring clips	460 22
1	Conductors/insulators, set of 6	567 06
1	Optical bench, S1 profile, 1 m	460 310
3	Clamp rider with clamp	460 311
1	PC with Windows 2000/XP/Vista/7/8	

### Experiment setup (see picture)

Plug the lamp into the lamp housing. Cut off a strip of white paper (matching the dimensions used in the conductors/insulators set: 1.5 cm x 8 cm) and clip it into a holder with spring clips. Connect the lamp to the 6-V output of the transformer and set it up in such a way that a bright area appears on the paper strip next to the fibre holder (an unfocussed image of the hot filament). Turn the fibre holder till the fibre points at this area.

### Performing the experiment

#### *Recording the reference spectrum*

- Activate  to begin a new measurement.
- Select the **Intensity I1** display.
- Start the measurement with .
- Adapt the integration time, either directly or with  or , such that maximum intensity lies between 75 % and 100 %. Do not change the integration time again after this.
- In order to record the background spectrum, remove the paper strip and turn off the lamp.
- Open the **Offset I0** display.

- The displayed spectrum will be removed from subsequent measurements as the background spectrum.
- Change to the **Reference I2** display.
- Clip the paper a strip back into the holder with spring clips and turn on the lamp.
- The displayed spectrum serves as a reference spectrum for the following measurement. Suspend reference measurement with **II**.

*Recording reflection spectra (reflection from various materials)*

- Remove the paper strip from the holder and replace it in turn with each of the samples from the conductors/insulators set.
- The spectrum after reflection of light by the strips can be viewed in the **Intensity I1** display. The reference spectrum is also displayed in grey.
- For the **Transmission T display**, the relationship between the reflected spectrum and the reference spectrum is calculated and displayed.
- The **●** control can be used to save the reference spectrum for all displays simultaneously.

## Evaluation

In the reflection spectra for aluminium (red) and polystyrene (violet) there is a roughly uniform dimming effect across the whole region, i.e. particularly in the visible region from about 400 to 800 nm (in this example the dimming is by 60 to 80 % and by 70 to 85 %). For this reason, both these materials look grey.

In the reflection spectra of wood (blue) and brass (black) there is clear dimming in the short-wavelength region, i.e. the blue part of the spectrum. For this reason, the materials have a yellowish colour (the complementary colour for blue). It is also clear that there is more red in the spectrum for wood.

Since the dark Pertinax (green) reflects mainly red and infrared components with a wavelength greater than about 750 nm, it looks almost black.

Transparent acrylic (dark blue) scatters no light, i.e. no light is reflected towards the fibre.

## Notes

In this experiment, the scattered light of the directed light beam from the lamp is primarily observed from a fixed angle (diffuse reflection). For the reflective surfaces (brass, Pertinax, acrylic) a large part of the reflection is specular, i.e. not reflected in the direction of the fibre.

It is also recommended that other materials be used for reflection experiments. In particular, it is possible to view plant leaves, which absorb light in the red and blue regions (chlorophyll bands) and reflect light in the green region.

Using colour filters, i.e. not white light, the materials will look different in colour depending on their reflective properties and these colours should also be identifiable in the reflection spectrum. The room should be darkened so that there is no error in the results due to ambient light.

In the **Transmission** and **Extinction** displays, only those ranges are evaluated whose intensities in the reference curve amount to at least 2 %.

The **Σ** control can be used to reduce noise by averaging multiple individual spectra (also Offset and Reference). Alternatively, [Smoothing to 1 nm resolution](#) can be set in the settings options.