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**Techniques:** VIS - spectroscopy
**Applications:** Material characterization

# Optical Scattering by Dense Disordered Metal Nanoparticle Arrays

Prepared by: Krista Klismeta

Azobenzene containing compound thin films change their optical properties if radiated by polarized and non-polarized 532 nm laser light. This is due to the photoinduction effect. Under influence of light azo compounds experience trans-cis isomerisation process, that can be observed in the absorbance spectrum of the azo compund containing material. This effect may be used for making building novel all optical switches, data storage devices and other optoelectronic devices in a comparably cheap organic material. In this application the use of Ocean Optics spectrometer is demonstrated for the characterization of the changes that are taking place in the prepared samples.

**Background**

When irradiating azo compounds with UV or visible light, they experience trans-cis photoisomerisation process. Stable trans configuration may undergo a transformation to the metastable cis configuration. It can be detected by recording absorption spectra of the polymers that hold the azo compounds. The incident light electrical field aligns the azo moieties perpendicular to the direction of light polarization. This may create birefringence and dichroism. It has been shown elsewhere that highly efficient surface relief gratings (SRG) can be optically induced on surface of azopolymer films. To induce mass motion one of the used methods are holographic recording. A periodical intensity pattern can be obtained at the submicron scale by formation of SRG on the azobenzene containing polymer films. SRG formation strongly depends on the polarization state of the two recording beams. Mentioned properties of azobenzene containing compounds suggest that these materials could have potential application in various photoactive devices, optical information storage and telecommunication, nonlinear optics and production of diffractive optical elements.

**Experimental Setup**

By measuring photoinduced changes of optical properties, including mass motion, in Poly(Disperse Red 1-methacrylate) thin film under influence of polarized and non-polarized 532 nm laser light, we can experimentally investigate photoinduced changes of optical properties. Experimental setup used for capturing the absorption spectrum while irradiating the sample with polarized and non-polarized 532 nm laser light is shown in Fig. 1 below.

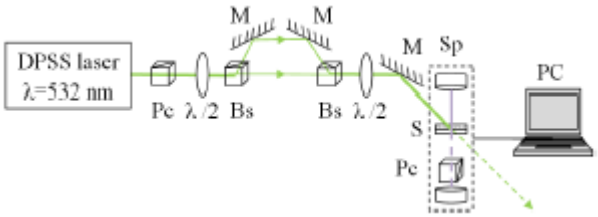


**Fig. 1.** Experimental setup for studying the absorption spectrum while irradiating the sample with polarized and non-polarized 532 nm laser light: Bs – beam splitter, F – neutral density filter, L – lens, λ/2 – half wave plate, M – mirror, Pc – polarisation cube, PC – computer, S – sample, Sp – Ocean Optic HR4000CG spectrometer

Glan-Taylor polarization cube was used to improve polarization of laser beam and half-wave plate is used to control the polarization state – change the light polarization to linear, orthogonal or parallel to the spectrometer light probe polarization. The spectra were registered using Ocean Optic HR4000CG spectrometer. For more details, see ref. [1].

**Results**

Fig. 2 shows the absorption spectra which were recorded while irradiating the sample with polarized and non-polarized 532 nm laser light. The thickness of the sample was around 160 nm. Sample was irradiated for 10 seconds and then the spectra were taken. The laser intensity was 0.2 W/cm$^2$. If the sample is irradiated with nonpolarized light photoisomerisation effect is observed – some of the stable trans isomers transform into cis isomers. As a result absorption of cis isomer at 340 - 400 nm increases and absorption of trans isomer at 420 - 500 nm decreases. If sample is irradiated with polarized pump beam, moieties photoisomerize and obtain and orientation. It was observed that the absorption of trans isomer of azobenzene molecules is greater in the direction perpendicular to the polarization of the pump beam. If the polarizations of pump and probe beams are parallel, the absorption is respectively smaller because of the dichroism phenomenon and also because in this case greater number of moieties experience photoisomerisation, thus concentration (and absorption) of trans isomer decreases.

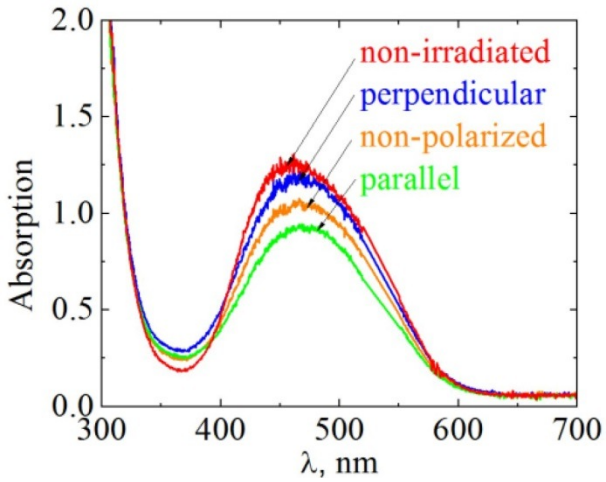


**Fig. 2.** The captured absorption spectra of non-irradiated sample and while irradiating with

**Conclusions**

Under influence of 532 nm laser light, moieties of poly(Disperse Red 1- methacrylate) photoisomerise and obtain an orientatio so that the absorption is greater in the direction which is orthogonal to the electric intensity vector of the pump beam and smaller if the vector is parallel.

**References**

1. K Klismeta, J Teteris and J Aleksejeva, IOP Conf. Series: Materials Science and Engineering 49 (2013) 012036 doi: 10.1088/1757-899X/49/1/012036