

Ellipsometry

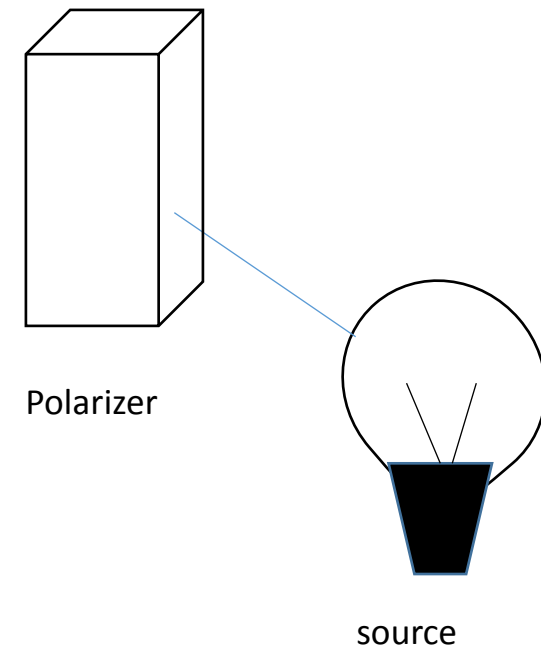
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INTRODUCTION

- Measures change in polarization of light as it reflects or transmits from the sample.
- Provides information about amplitude ratio, ψ and phase change, Δ .
- This helps in determining refractive index, roughness and film thickness.

WORKING



SOURCE

50 W Quartz tungsten halogen lamp

Consists of tungsten filament and inert gas with small amount of halogen gas.

Application of voltage evaporates tungsten.

Tungsten reacts with halogen.

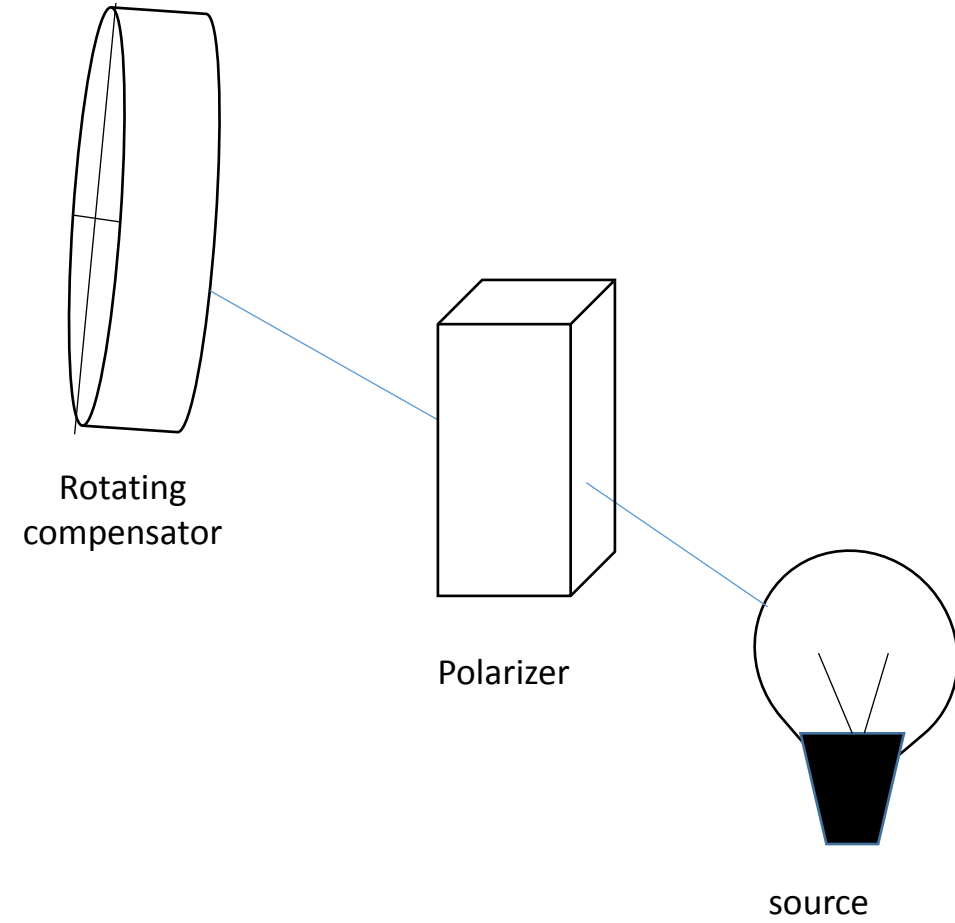
At higher temperature the halide dissociates, tungsten is deposited on the filament.



POLARIZER

Polarizes the incoming light.

WORKING



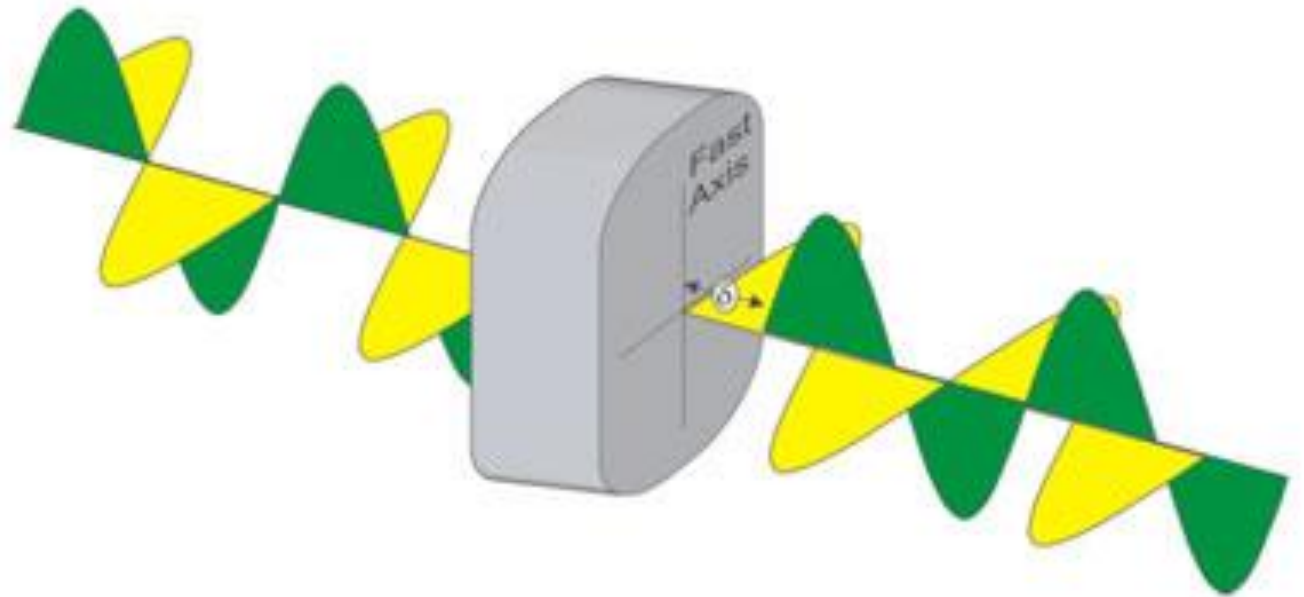
Rotating Compensator

Fast and Slow axis

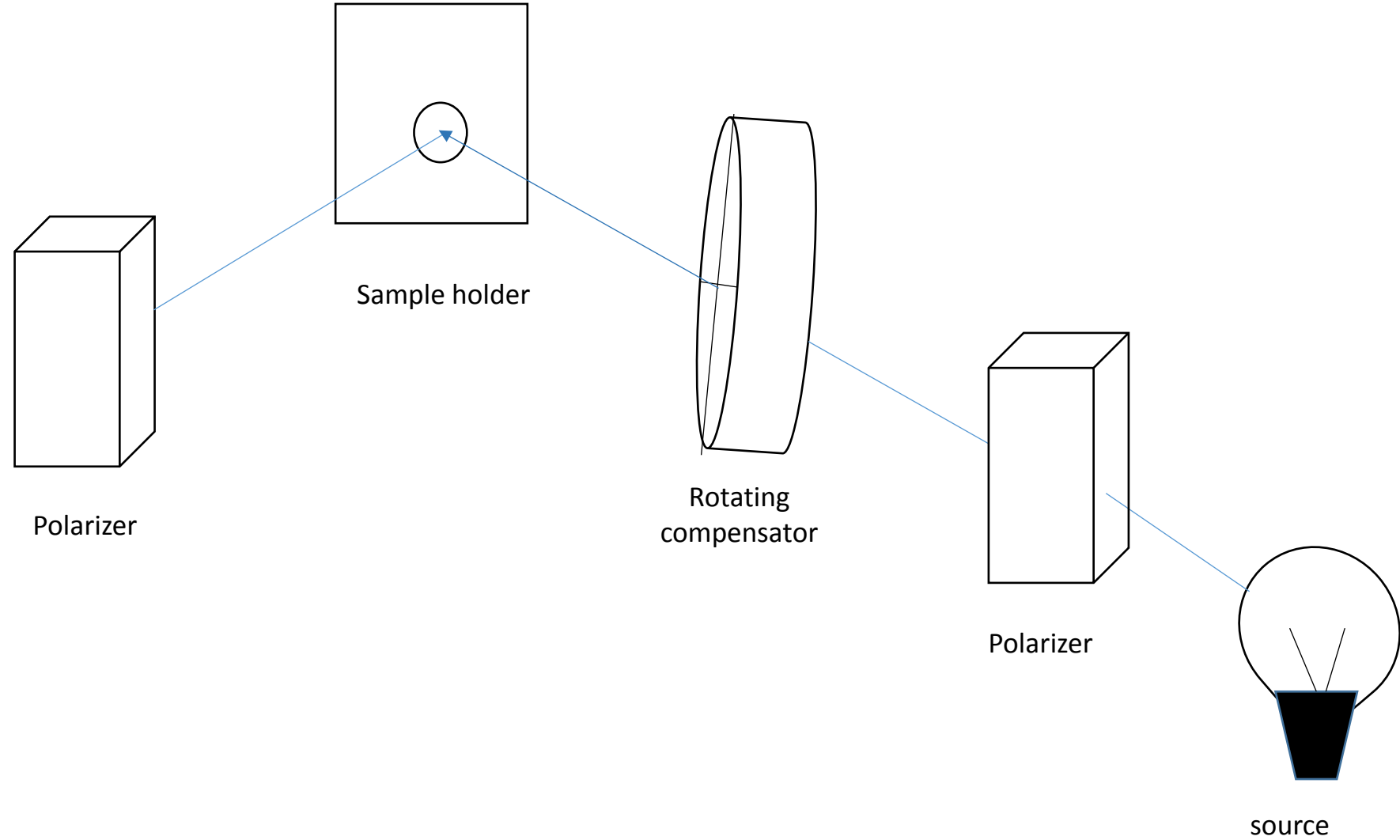
Delays phase by 90° if aligned along the axis

Increases sensitivity of Δ .

Helps in measuring depolarization effects.



WORKING



Sample holder

Uses vacuum to hold sample in place.

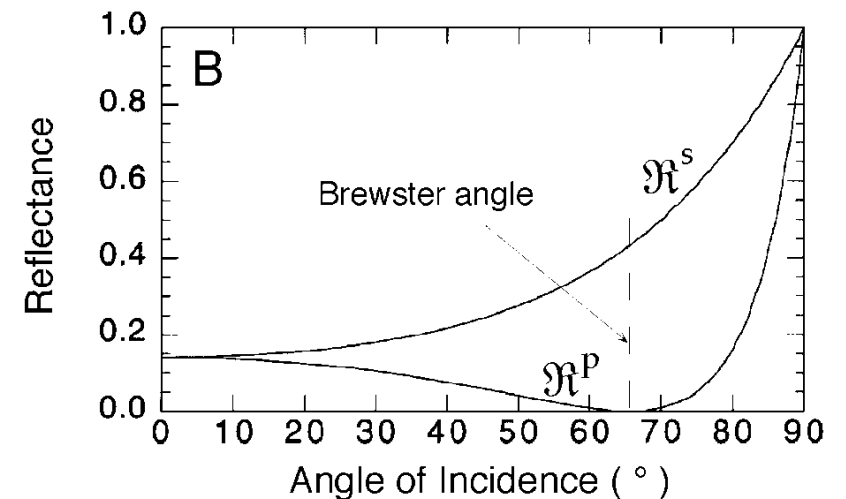
X, Y and Z adjustments to align the sample.

Data is collected at multiple angles (35-75°).

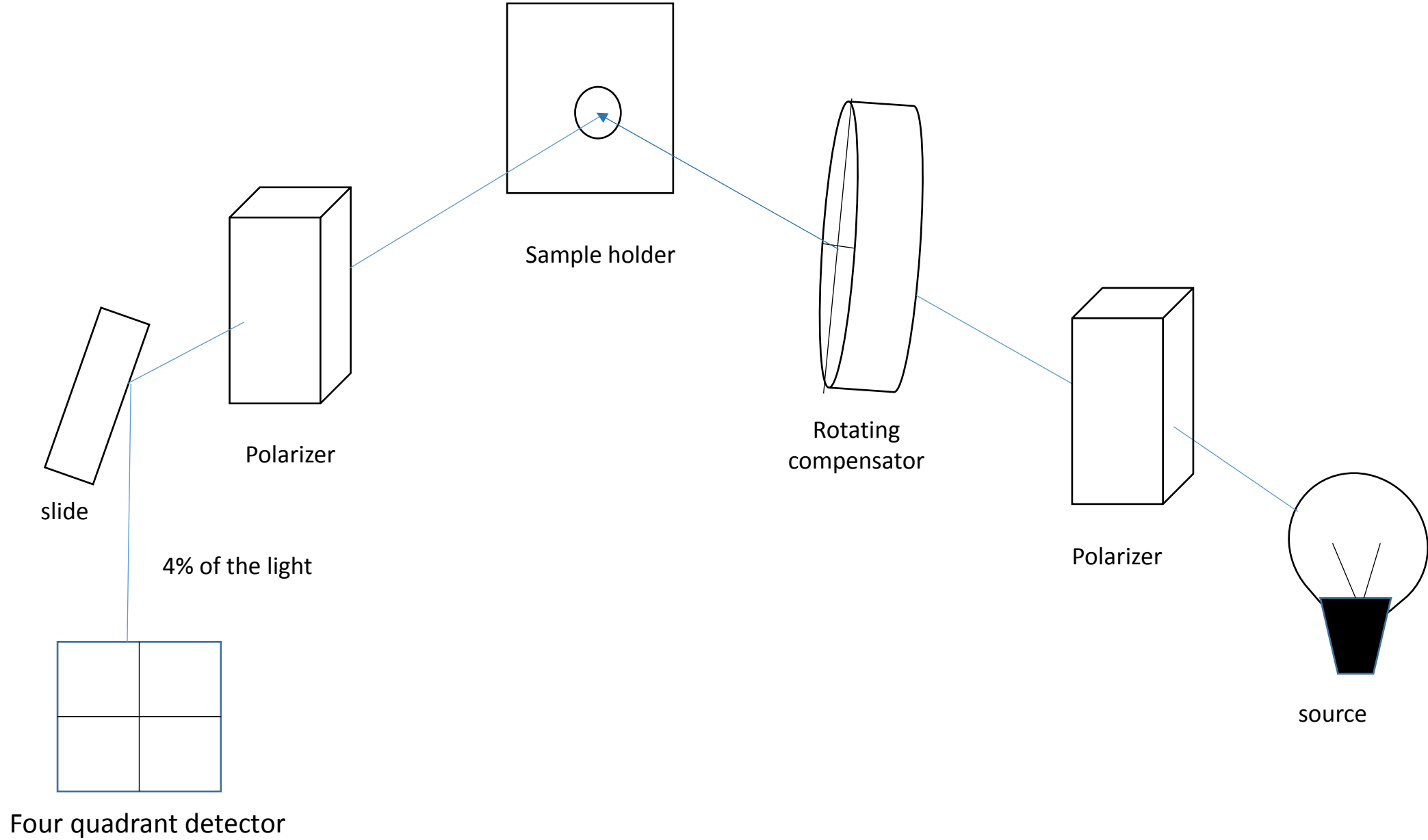
Measurement is done close to Brewster angle of the sample.

In case of wetting experiments, wetting cell is used

Data is collected at single angle (75°)



WORKING

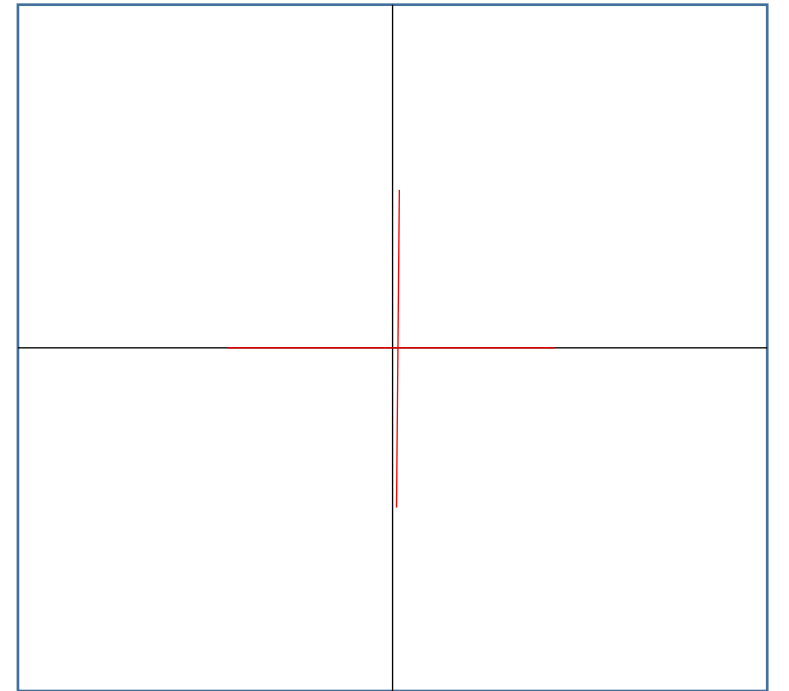


Four quadrant detector

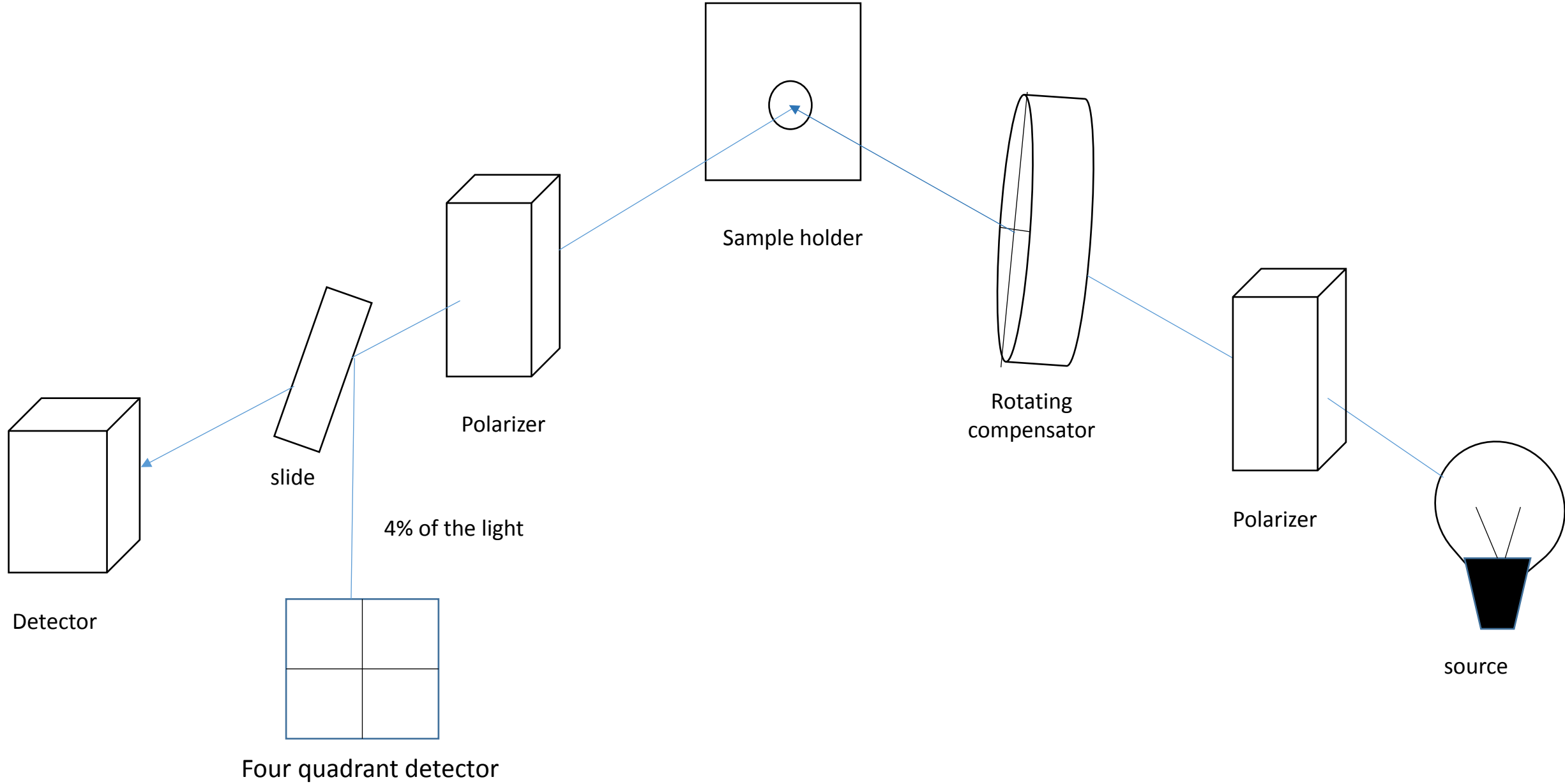
Used to align the sample.

4 % of the light is reflected from the slide towards 4 quadrant detector.

To make sure sample is held flat and the beam is centered.



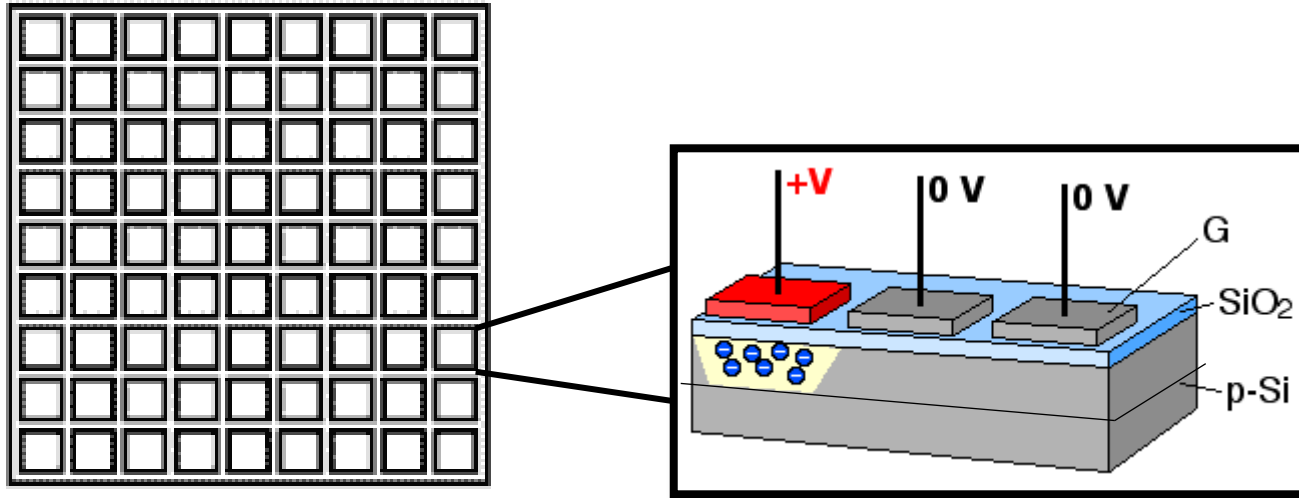
WORKING



COMPONENTS

Detector

Charge coupled device



Consists of large number of light sensitive elements (pixels).

Incident photon separates electrons and holes.

Electrons are attracted and moved by application of positive voltage.

Ellipsometry: Coating Thickness

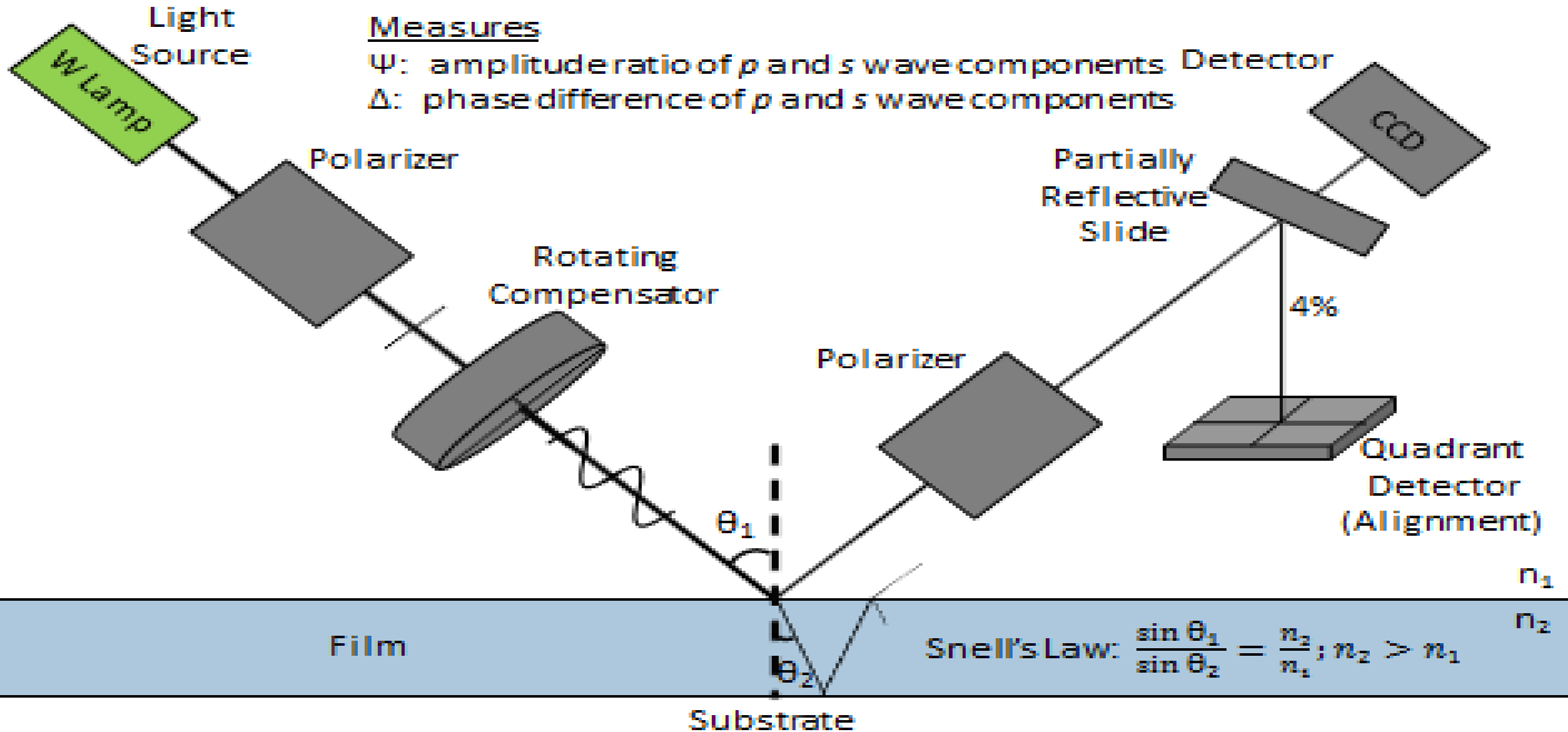


Figure 22. Ellipsometry block diagram.

Wave Polarization

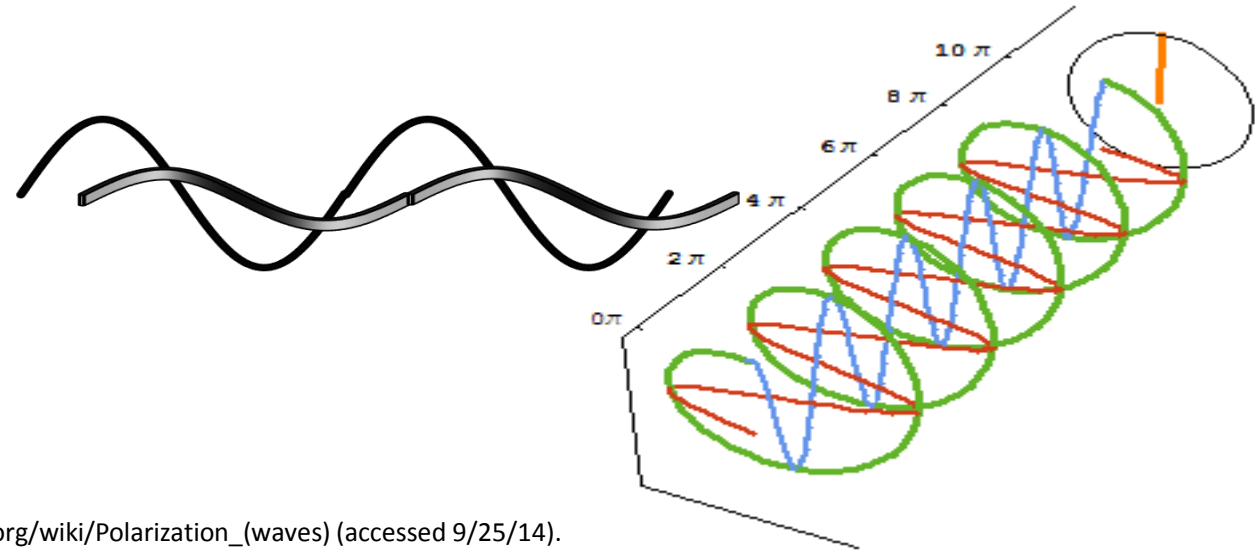
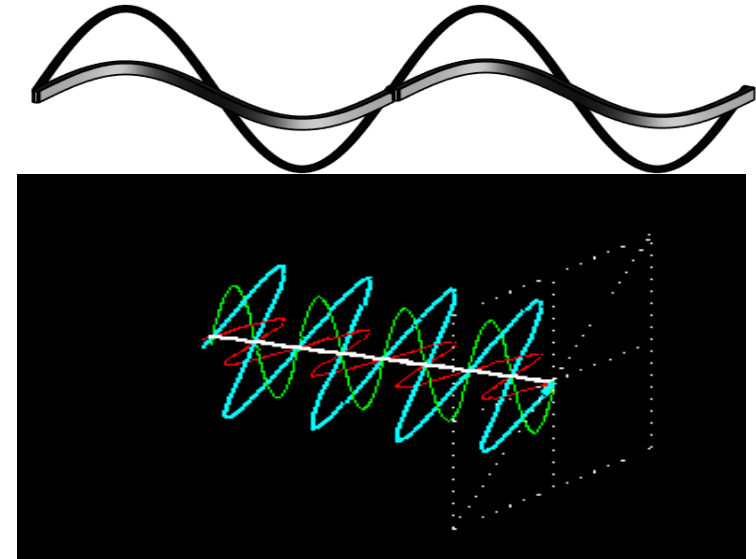
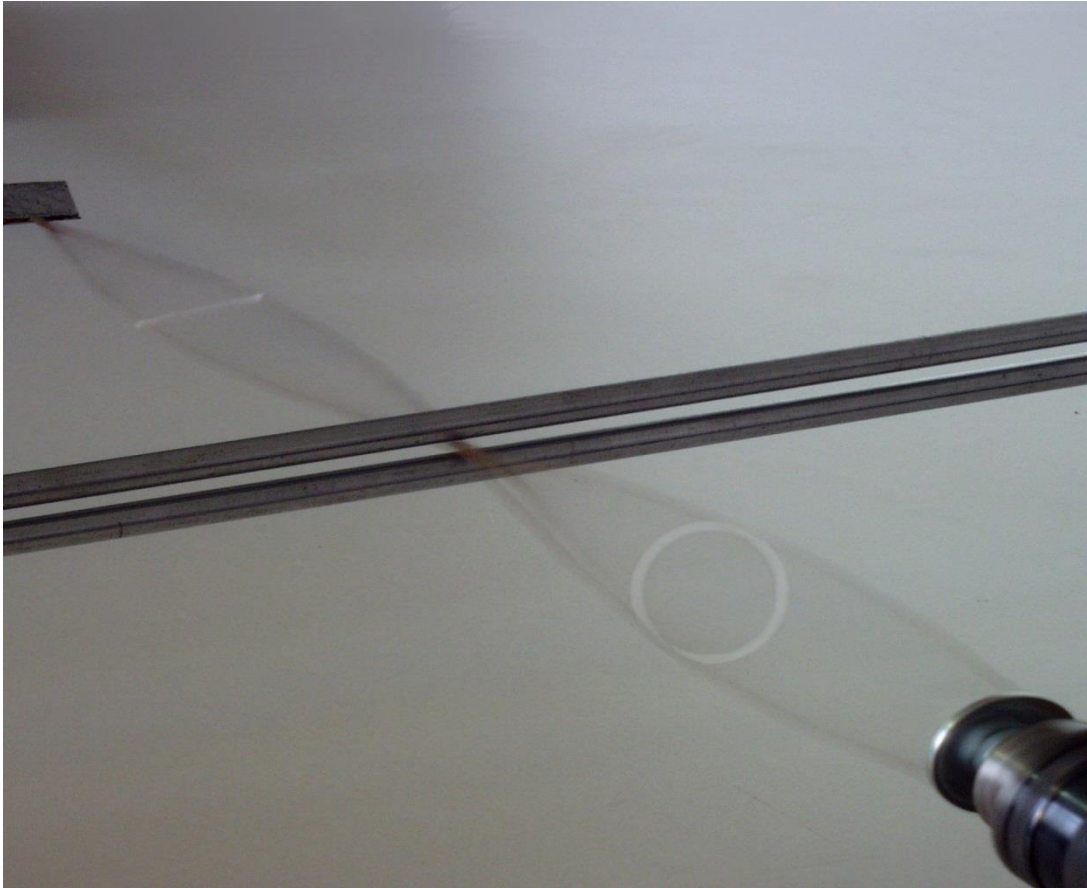
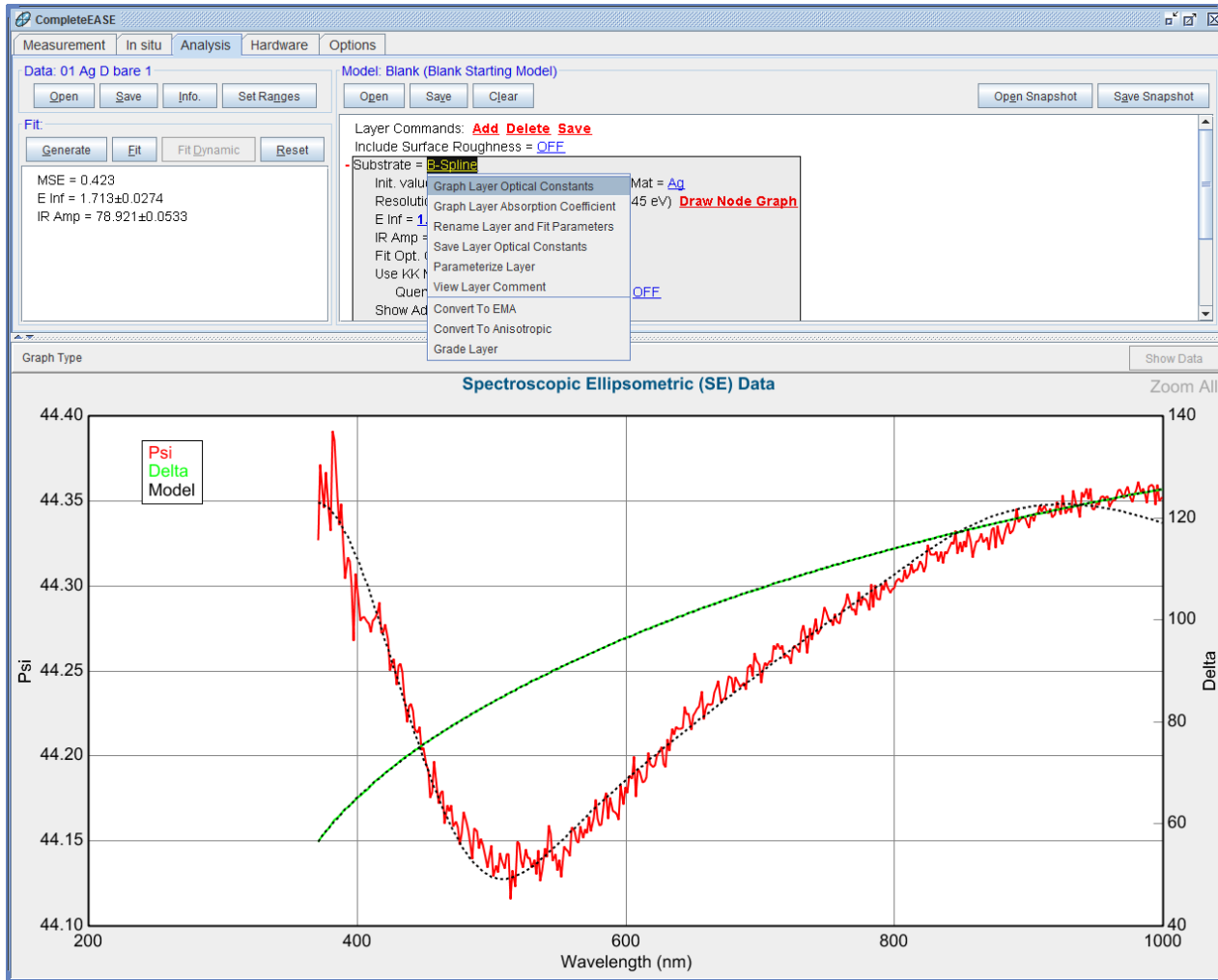


Figure 23. Image (left) and animations (right) of wave polarization.

Polarization (waves). Wikipedia. en.Wikipedia.org/wiki/Polarization_(waves) (accessed 9/25/14).
Physics Forum. <http://www.physforum.com/index.php?showtopic=6587&st=4125> (accessed 9/25/14).
SUNY Buffalo. <http://www.physforum.com/index.php?showtopic=6587&st=4125> (accessed 9/25/14).

DATA ANALYSIS



$$r_s = \frac{n_i \cos\Phi_i - n_t \cos\Phi_t}{n_i \cos\Phi_i + n_t \cos\Phi_t}$$

$$r_p = \frac{n_t \cos\Phi_i - n_i \cos\Phi_t}{n_i \cos\Phi_t + n_t \cos\Phi_i}$$

$$\tan \psi e^{i\Delta} = \frac{r_p}{r_s}$$

DATA ANALYSIS

