

Surface Plasmon Resonance Test Apparatus

Ty Funk¹, Robert Fetcho², Michael Prodzenski²
Advisor: Venu Korampally²

¹Mechanical Engineering and ²Electrical Engineering



NORTHERN ILLINOIS UNIVERSITY
College of Engineering and
Engineering Technology

Abstract/Introduction

NIU's Electrical Engineering course, Biomedical Sensor Engineering (ELE 421), requires a device to help students understand the SPR effect. This effect is found when graphing the angle of incidence versus light intensity. The SPR angle is the angle of minimum intensity. The designed unit fixes this sample at the intersection point of a laser emitter and its respective receiver circuit to detect the intensity of reflected light.

Project Requirements:

- P-polarized light
- Maximized angular range
- Modularity
- Portable (liftable by 1 person)
- Cheaper than standard SPR devices (below)



Figure 1: A SPR measurement device by NANOSPR (\$15,100) ¹



Figure 2: The VASE Ellipsometer (>\$20,000) ²

Methods and Materials

Using stepper motors, two trolleys are programmed to move along a semicircular rail and take measurements of the SPR curve
Laser trolley: 3D printed (SLA) with replaceable laser pointer and interchangeable lens
Receiver trolley: Replaceable circuit board and adjustable height
Additional items: Installable prism, separate power supply, and Arduino

Appearance

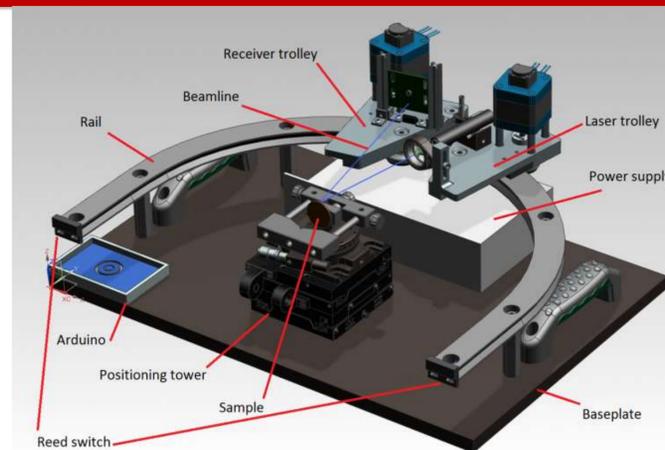


Figure 3: A 3D model of the designed device

Conclusion

The Apparatus discussed is greatly cheaper than the marketed variants of SPR measurement devices. The device will efficiently be used for teaching students about the SPR phenomenon. It can also be helpful for future experimentation within the college.

Results

Angle of incidence range: $180^\circ - 21.4^\circ$
Device weight: ~25 LBF
Adjustability: Wide X, Y, angle positioning
Approximate cost (excluding work time): \$1,500
Resultant plot (angle vs intensity):

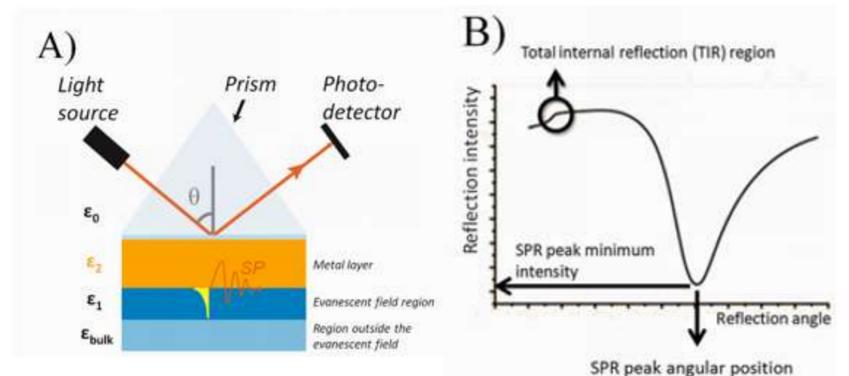


Figure 4: A representation of the device's output graph and reflection off a sample (a non-diffracted setup) ³

Acknowledgements/References

Dr. Venu Korampally – NIU ELE Faculty advisor and sponsor
Dr. Federico Sciammarella – Former NIU MEE Faculty provider for optical lab access

1. "VASE Ellipsometer," J.A. Woollam. [Online]. Available: <https://www.jawoollam.com/products/vase-ellipsometer>. [Accessed: 09-Apr-2020].
2. "Surface Plasmon Resonance Spectrometer," NanoSPR Devices. [Online]. Available: <https://nanospr.com/nanospr6-dual-channel-electrochemical-surface-plasmon-resonance-spectrometer/>. [Accessed: 09-Apr-2020].
3. J. Jatschka, A. Dathe, A. Csáki, W. Fritzsche, and O. Stranik, "Propagating and localized surface plasmon resonance sensing — A critical comparison based on measurements and theory," *Sensing and Bio-Sensing Research*, vol. 7, pp. 62–70, 2016.