# Prism Coupler

Precise Measurement of

Waveguide loss,

Refractive Index

and Film Thickness.

# SAIRON TECH

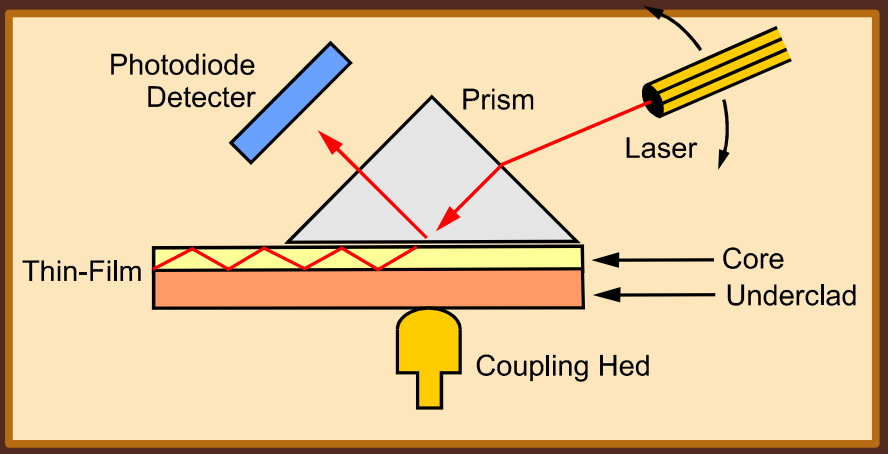
**The research of SaironTech (Established 1997) are specialized at the field industrial application and basic research for optical measurements. SaironTech are developed(1998. 12) and commercialized the prism coupler (SPA-series) which is measuring the refractive index, thickness of the film and bulk material, and the waveguiding loss measurement.**

# Principle of Prism Coupler

① Incidence Laser light
→ totally reflected at the base of the prism
② Proper orientation of the direction of the incidence beam
→ Coupled through their evanescent fields in the gap.
→ Permits excitation of anyone of the film waveguide modes.
③ Measurement for both Refractive Index and Thickness of the film.

## Advantages of Prism Coupler

- No advance knowledge required
- Unrelated Film/Substrate Combinations
- Dual-layer Film Measurement
- Bulk or Substrate Materials Measurement
- Anisotropy/Birefringence Measurement
- Thick-Film Measurement




Make a narrow gab between the prism and the film using coupling (push) head

# Principle of Loss measurement

## Index Matching Oil Method

① Waveguide light undergoes numerous total internal refractions inside the film.

② Immerse the film into the liquid oil, with the index of refraction slightly higher than that of the film.

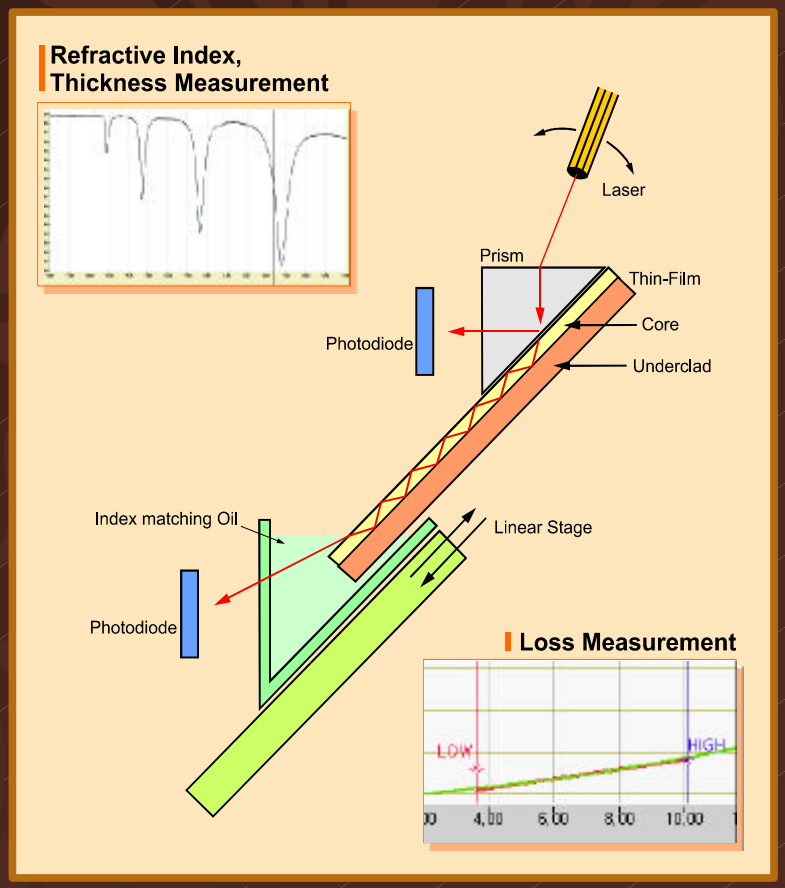
③ The light emerge out from the film at the intersection between the liquid surface and the film surface.

④ Detecting the outgoing light through the liquid oil.

⑤ Recording the intensity of the guided light as a function of propagation distance.

❖ **Highly precise measurement**

**down to 0.01dB/cm**

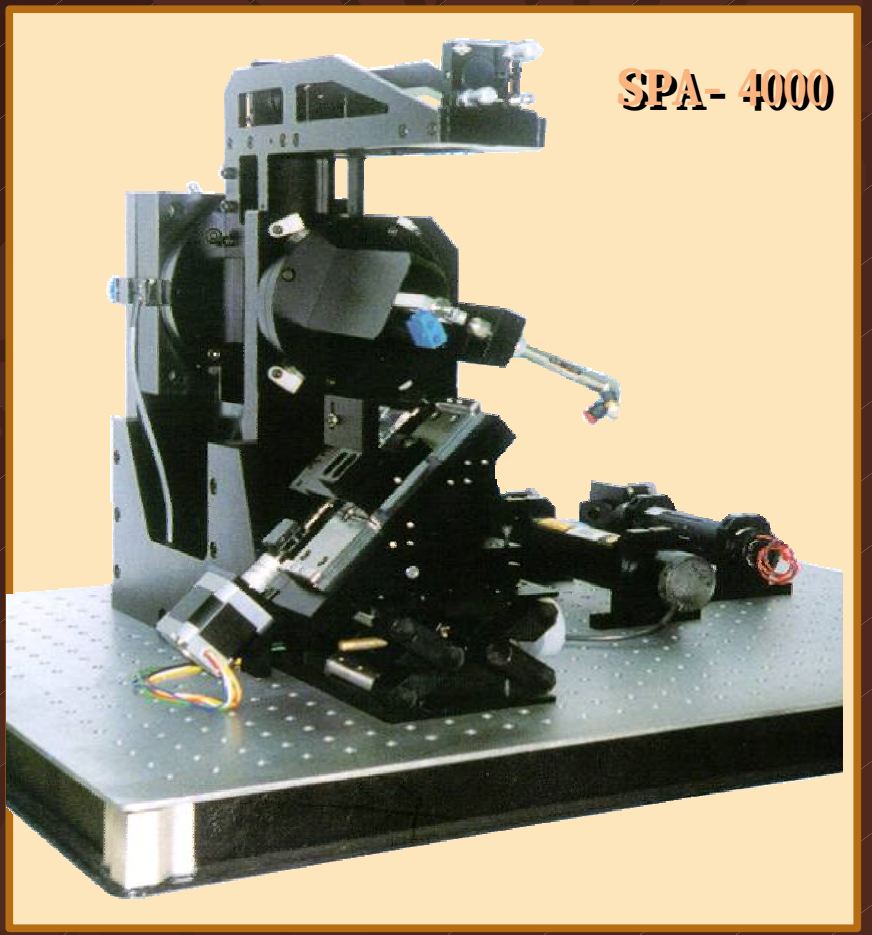


# Features of SPA-4000

- **Incidence laser light :: Rotation**
- **Prism and sample :: Fix**
- **Index matching oil method**

**:: Loss measurement**

- Sample size : Min. 1cm*1cm to Max. 4-inch
- Sample length for loss : more than 3cm
- Loss measurable length : above 5cm

# Performance

| Measurements | Specifications | |
|---|---|---|
| Refractive Index | Index measuring range | 1.0 to 2.45 |
| | Index accuracy | 0.001 |
| | Index resolution | ±0.0005 |
| Thickness | Thickness measuring range | 0.4um~ 20um |
| | Thickness accuracy | ±(0.5%+50Å ) |
| | Thickness resolution | ±0.3% |
| Bulk (index only) | Index accuracy | 0.0005 |
| | Index resolution | ±0.0001 |
| Thick film (thickness only) | Thickness measuring range | 2um ~150um |
| Liquid (index only) | Index measuring range | 1.0 to 2.4 |
| | Index accuracy | ± 0.0005 |
| Loss Measurement | Measuring limitation | below 0.01dB/cm |

# SPA-4000 Specification

| | |
|---|---|
| SPA-series | include 632.8nm He-Ne Laser |
| | include GGG(n=1.965) prism & Holder ( index : < 1.8) |
| | include One controller and PC interface(RS-232) |
| | include Analysis software (O/S : MS-windows_ Labview) |
| | include Si-photodiode Detector |
| Options | Laser Diode Module (405 ~1550nm); user choice |
| | TM Mode option for each wavelength |
| | Ge-Detector for INFRARED Laser |
| | Rutile(n=2.865) PRISM for high index refraction ( index : 1.8 ~ 2.45) |
| | THICK-film measurement system |
| | LIQUID measurement system |
| | Waveguide LOSS measurement system |

# Application Fields

| Film Types | | Substrate Types |
|---|---|---|
| Silicon Nitride | | Silicon |
| Silicon Dioxide | Silicon Oxynitride | GaAs |
| Low-k films | | Quartz |
| Polymers | Polyimides | Glass |
| Zinc Sulfide | Titanium Dioxide | Sapphire |
| Sapphire | Epi Garnet | GGG |
| Photoresists | Holographic Gels | Lithium Niobate |

# Application for SPA-4000

- **Optical components for optical communication systems**
  - **polymeric optical waveguide components**
    - **Optical Switches**
    - **Variable Optical Attenuators(VOA) for WDM(Wavelength Division Multiplexing)**
    - **Low optical propagation loss**
  - **Controllability of refractive index and birefringence**

  **USERS : K-JIST( J.J. Kim, SPIE proceedings 7-11 July, Seatle, Washington, USA, 2002)**
  http://matlb.kjist.ac.kr/~optoelec/

  **ETRI ( M. H. Lee )**http://www.etri.re.kr/e_etri/rnd/ard.html

  **Samsung** http://www.sait.samsung.co.kr/newsait/res/er.html

  **LG Electronics** http://www.lgelite.com/eng/aboutus/oe.html

  **Jeon-nam Univ.** **http://physics.chonnam.ac.kr/bk21/**

- **Plastic Optical Fiber(POF)**
  - **Plastic Optical Fiber Amplifier(POFA) for Optical Communication**
    **High Temperature Polymers for Waveguides**
    **USERS : Hanyang Univ**
    http://infochem.hanyang.ac.kr/index_intro.html

# Application for SPA-4000

- **Properties of polymer**
  - **Investigation of chromic properties of polymer**
  - **Information display and processing**
  - **Storage Materials**

  **USERS :** KOREA AGENCY FOR TECHNICAL STANDARD (ATS) http://www.ats.go.kr/english/eng_home.asp

  **KRICT (E.K. Kim)** http://www.krict.re.kr/~cpl/index_e.html

  **Hyosung** http://www.hyosung.co.kr/eng/index.jsp

  **LG Chemical** http://www.rnd.lgchem.co.kr/english/research/information/overview_set.htm

- **Nano devices : MEMs, Micro-electronics**

  **USERS : ETRI** http://std.etri.re.kr/eng/

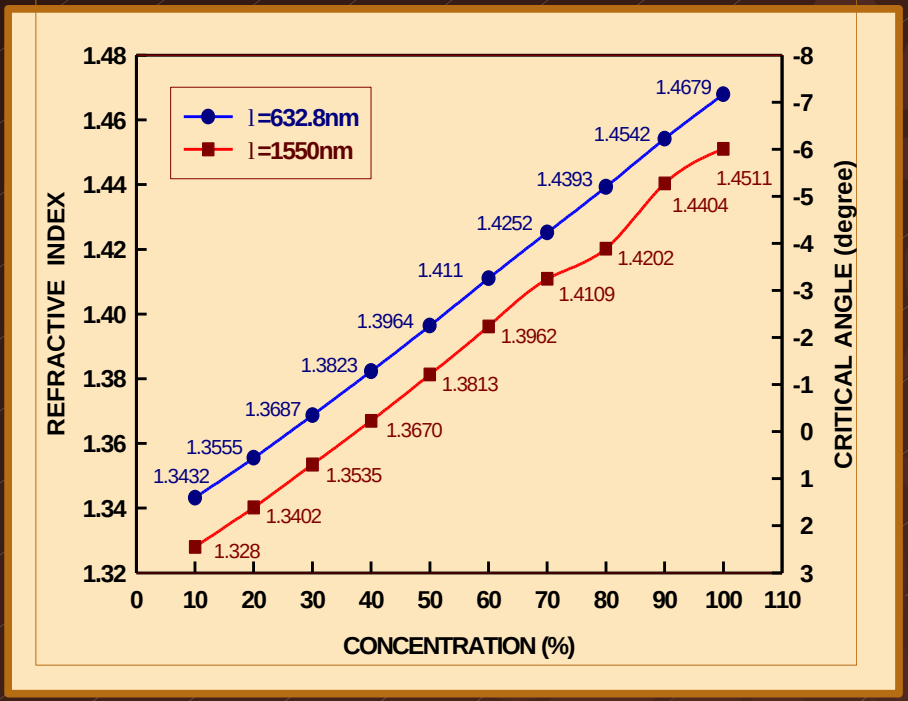
- **Temperature dependence**

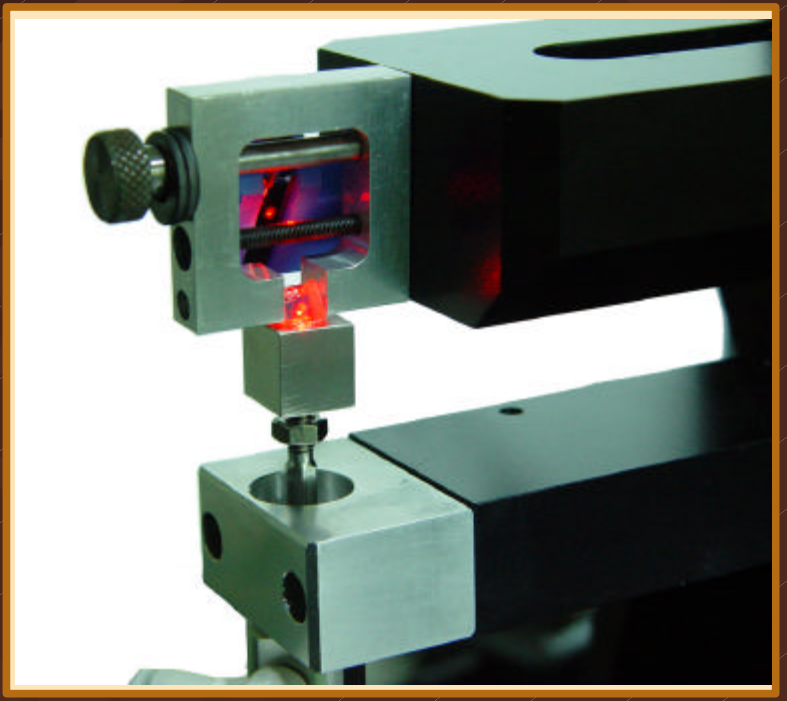
  **USERS : K-JIST( J.J. Kim)** http://matlb.kjist.ac.kr/~optoelec/

# Application : Liquid index measurement

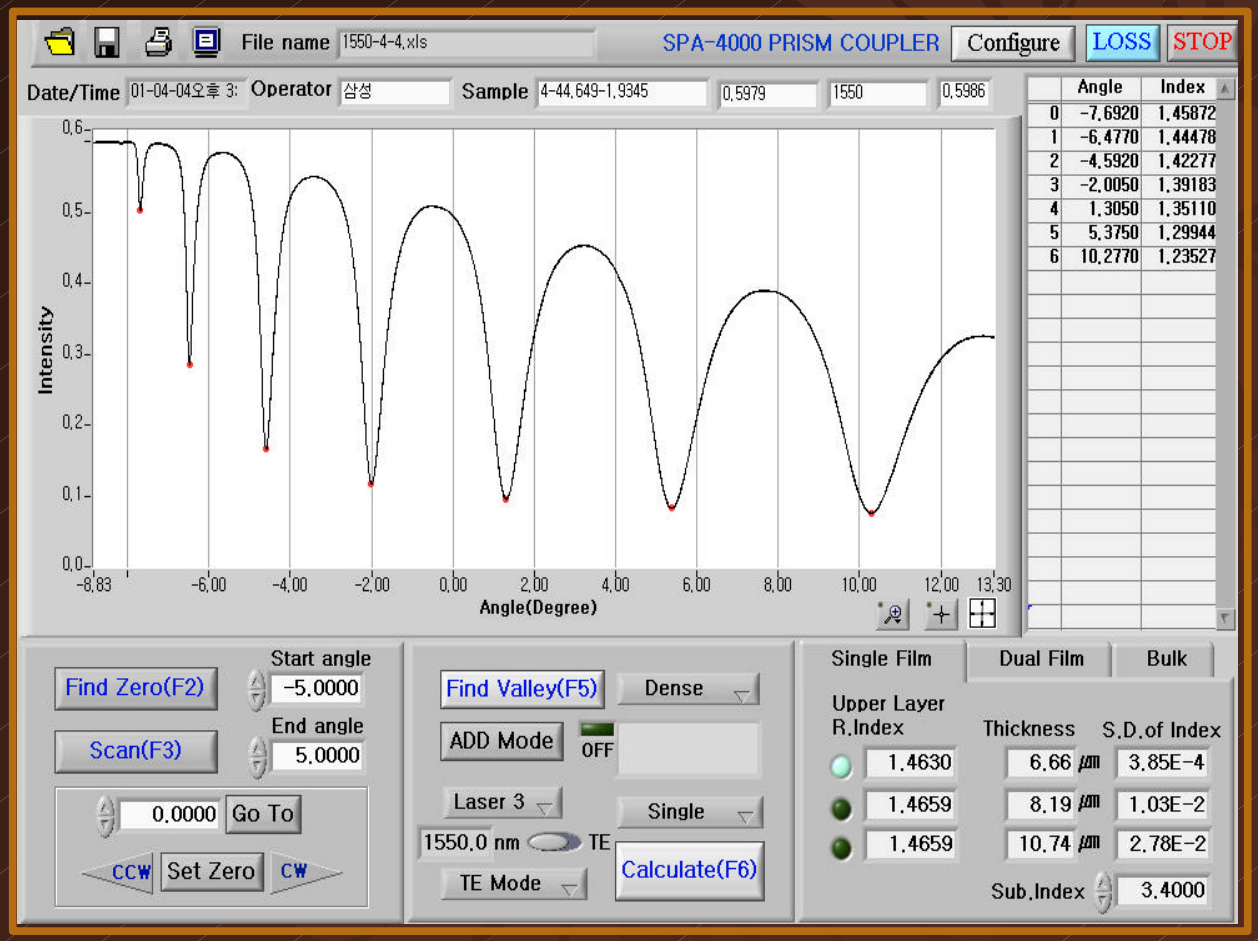
* Index range : 1.0 ~ 2.4
* Accuracy : **± 0.0005**

=> Electromagnetic dependence
=> Temperature dependence
=> Birefringence

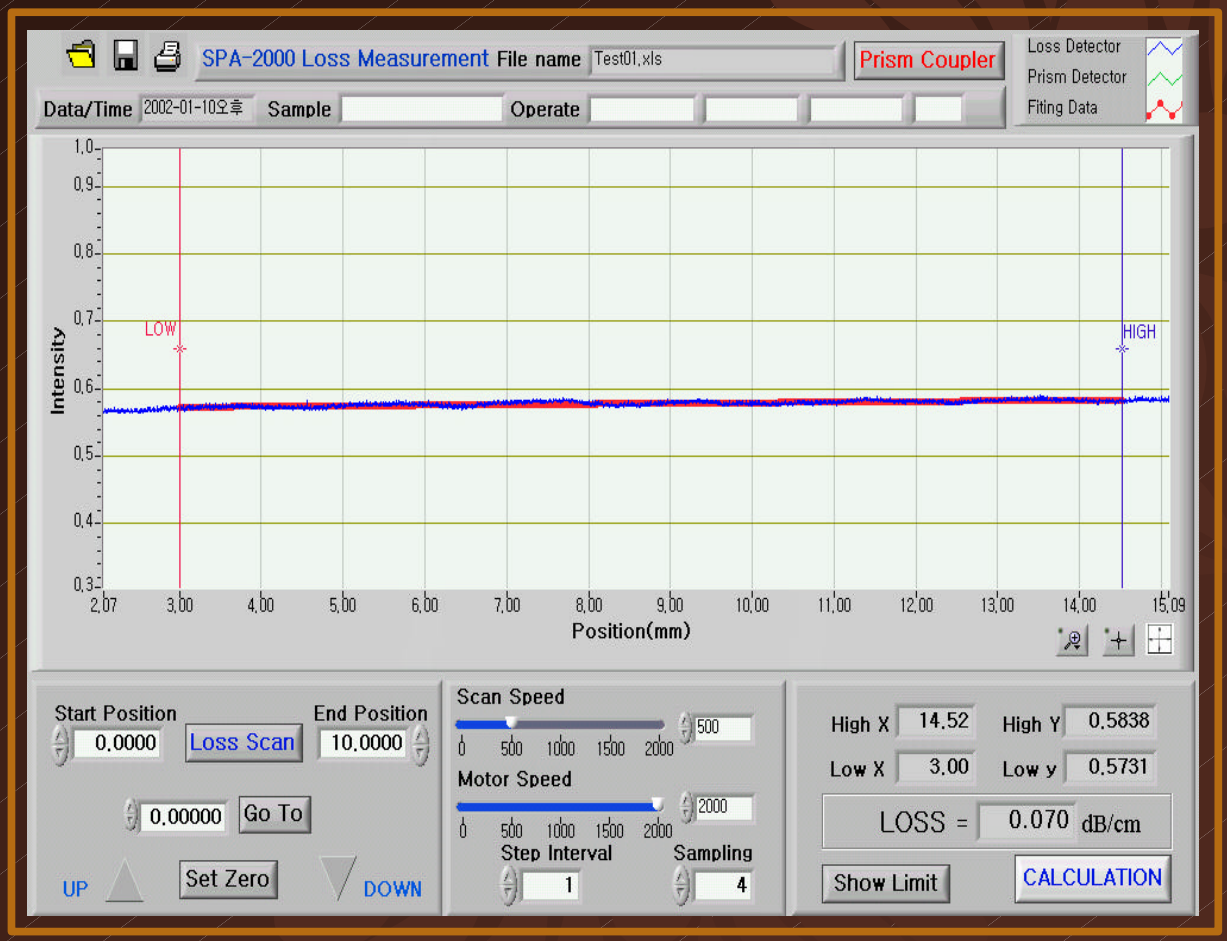


# Refractive index, Thickness Analysis GRAPH

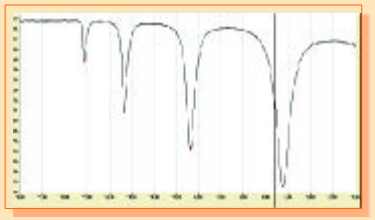


# Waveguide LOSS Analysis GRAPH



# Layout for Prism Coupler

**Refractive Index, Thickness Measurement**






**Loss Measurement**