Institute of Materials Research and Engineering

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Precision Ellipsometry

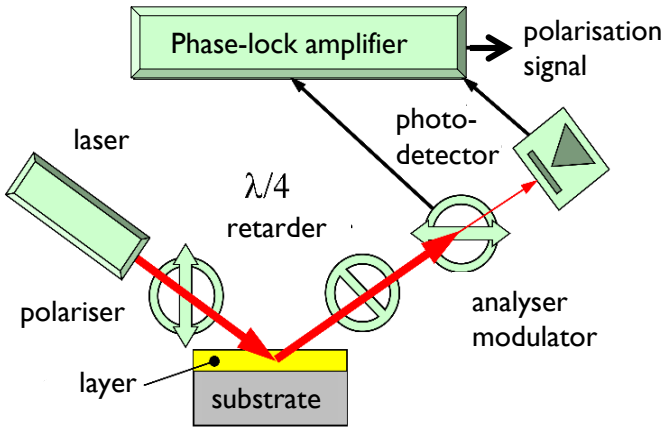
Ellipsometry is an analytical technique that measures the polarisation of light reflected off a surface.

In the electronics industry, it is used to measure the thickness of oxidation on silicon surfaces for wafer preparation.

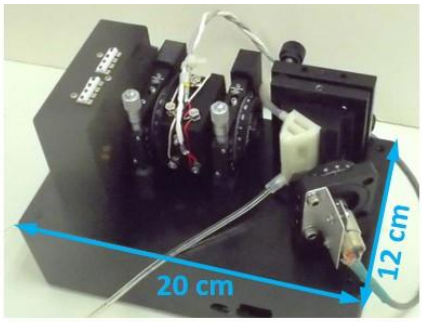
Currently, the technique requires the use of relatively bulkier lab equipment.

The IMRE Solution

An IMRE team developed a portable, battery-powered Precision Ellipsometry (PREL) system which has an increased sensitivity level that can measure ultra-thin films down to the molecular level, in real-time. The key to the performance of the PREL system is a polarisation modulator which allows the system to provide highly sensitive measurements, and yet be compact.



Schematic diagram of PREL system



Prototype of the PREL system device

Key Features

- Real-time measurement of reactions and molecular interactions at sub-nanometre molecular sensitivity
- Ability to measure layers on substrates which can be in gas, liquid or vacuum
- Low cost per test as relatively cheaper substrates are used
- Battery-operated, compact and portable device
- Potentially low device production cost

Potential Applications

- Biomedical (label-free) diagnostic tests
- Drug testing, e.g. measuring affinity of antibodies to antigens
- Measurement of kinetics of chemical reactions by fixing one of the precursors on the substrate
- Environmental monitoring "in the field" as device is portable, e.g. testing water and air purity
- Physics and Chemistry education – the PREL system places molecular science right on the desk

Collaboration Opportunities

- Joint development of the device with industry for higher sensitivity and automation
- Licensing of PREL technology
- Joint collaboration with educational institutions to develop courses using PREL

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A*STAR website: https://www.a-star.edu.sg/

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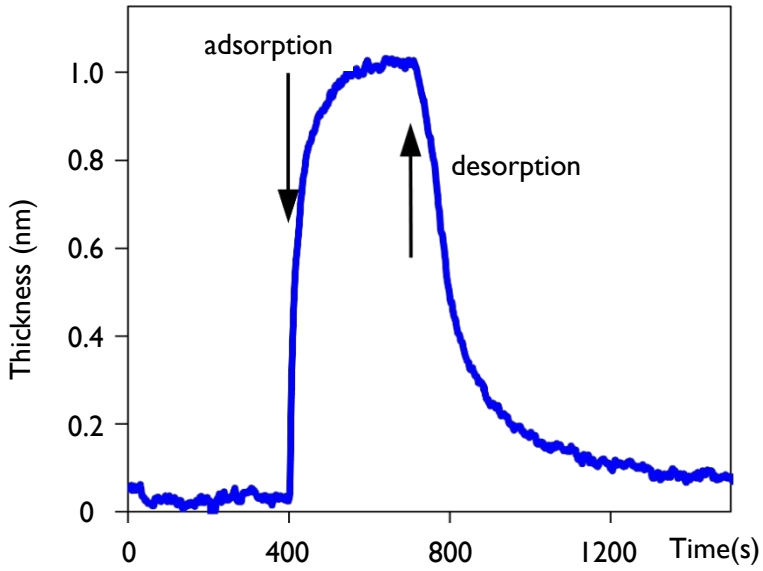
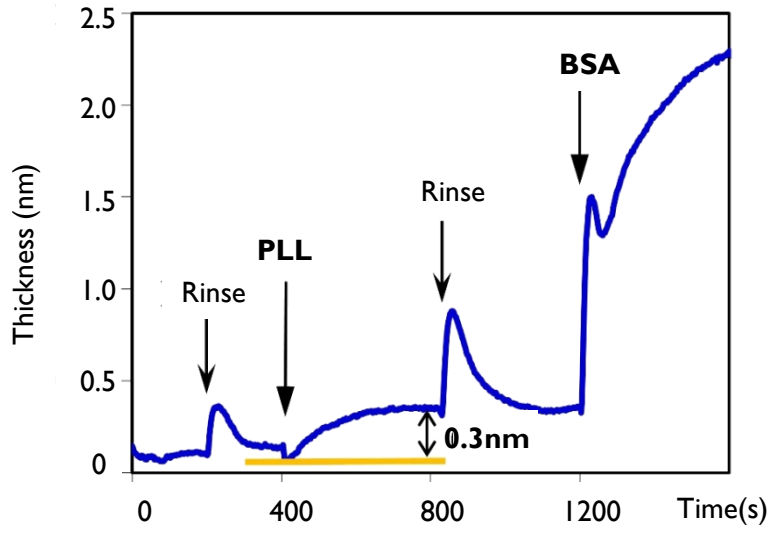
Performance Data:



Example of PREL substrate in air - adsorption and desorption of propanol on silicon surface



Example of PREL substrate in water - deposition of poly-L-lysine (PLL) and bovine serum albumin (BSA) on silicon substrate in optical cuvette

References:

- Yakovlev, et al., Surface and Interface Analysis, v.50 (2018)
- H.H.Lau, et al., J. Colloid and Interface Sci., v.505, p.332 (2017)