Biosensors & their applications

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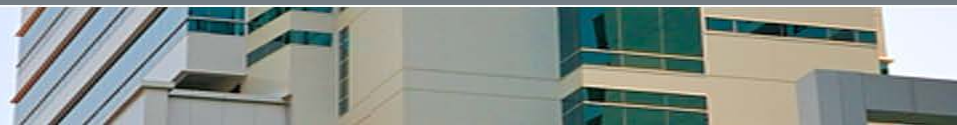
มหาวิทยาลัยศรีนครินทรวิโรฒ
SRINAKHARINWIROT UNIVERSITY

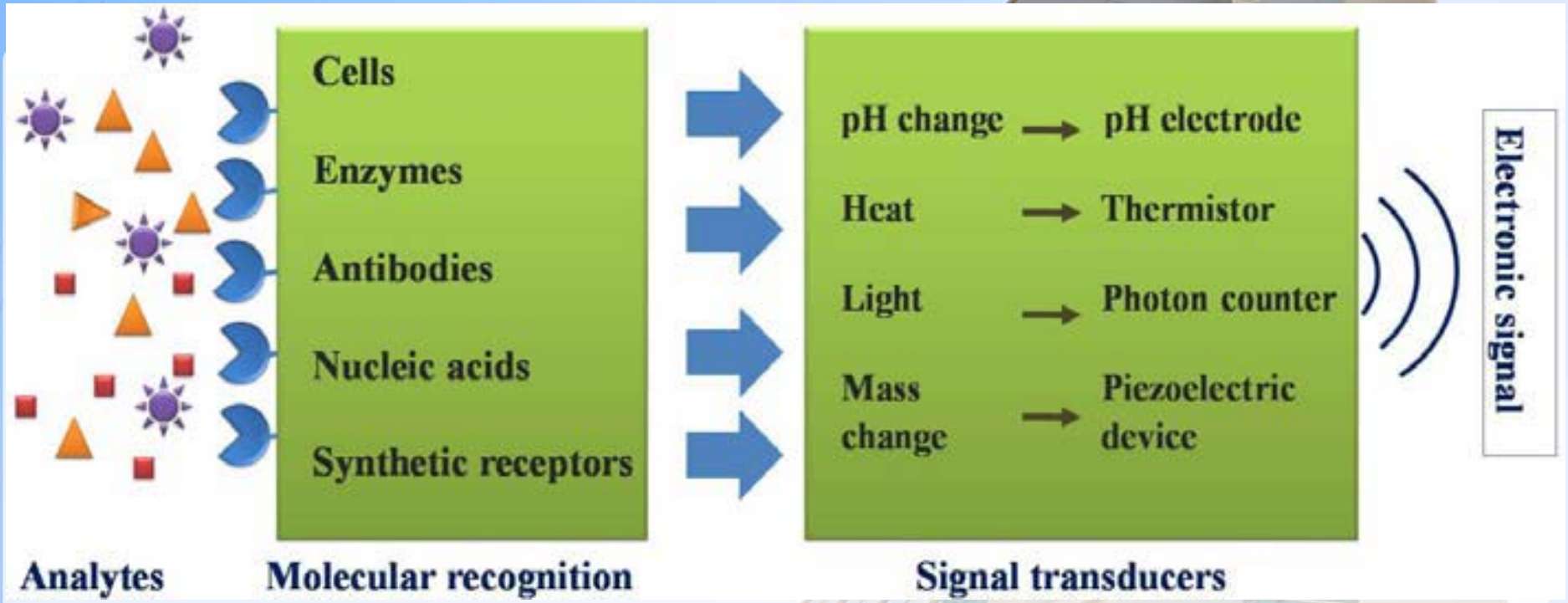


Biosensors

A biosensor is an analytical measuring tool comprised of a biological element of known molecular properties tightly coupled to a physical transducer responsible for converting the biological signal into quantifiable information.

(chemical or physical signal)

Principle of biosensing operation



Kaewphinit T, et al. (2013). Chapter 9: Quartz Crystal Microbalance DNA Based Biosensors for Diagnosis and Detection: A Review, Sensors and Biosensors, MEMS Technologies and its Applications, Advances in Sensors : Review, Vol.2

Receptors

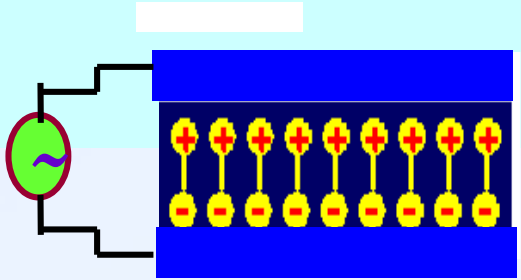
- Tissues
- Organelles
- Cell receptors
- Enzymes
- Antibodies
- **Nucleic acids**
- Synthetic receptors ect.

Transducers

- Optical
- Electrochemical
- Thermometric
- Piezoelectric
- Magnetic
- Colorimetric
- Lateral flow

Piezoelectric biosensors

Piezo-electric crystals (e.g. quartz) vibrate under the influence of an electric field. The frequency of this oscillation (f) depends on their thickness and cut, each crystal having a characteristic resonant frequency.



Mass sensitive

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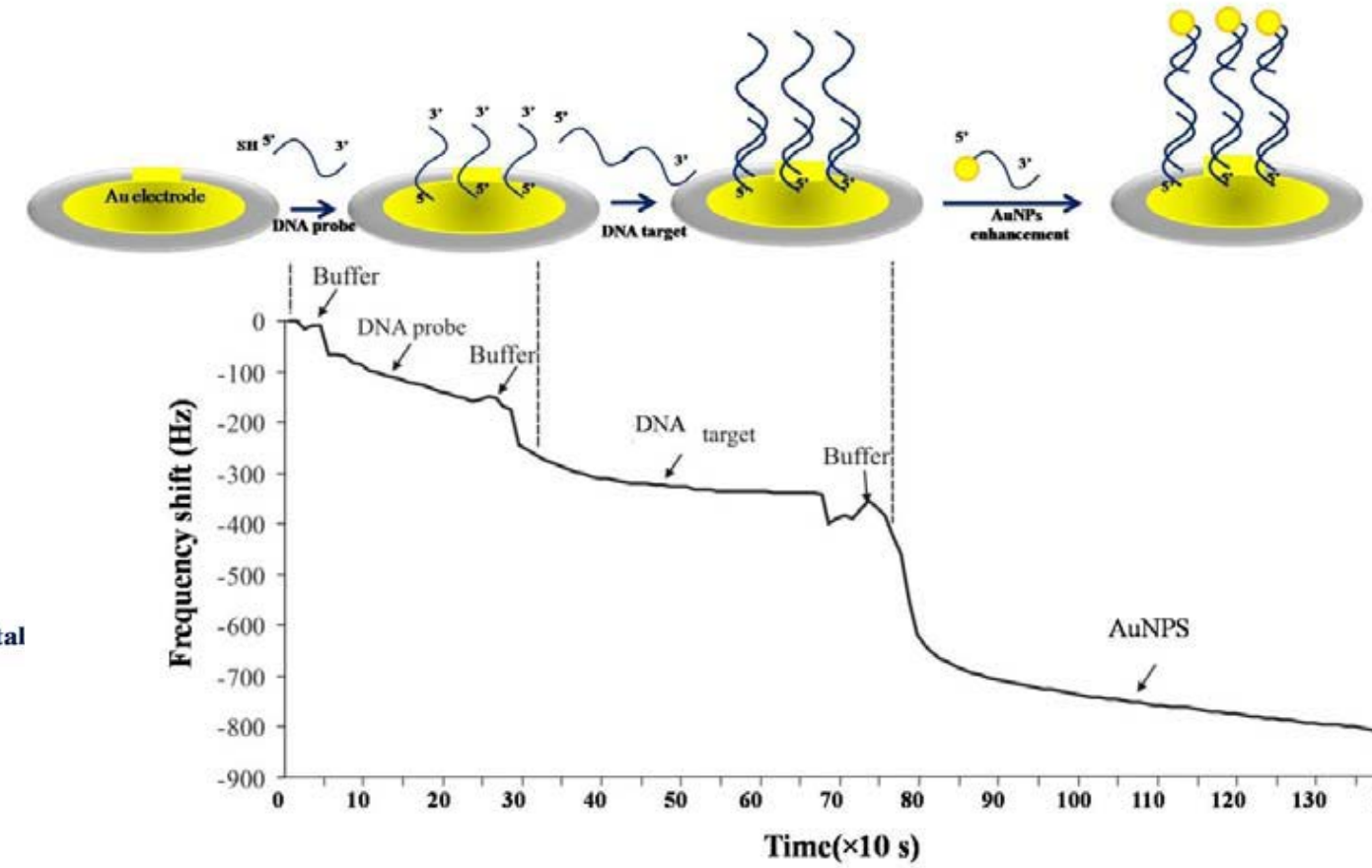
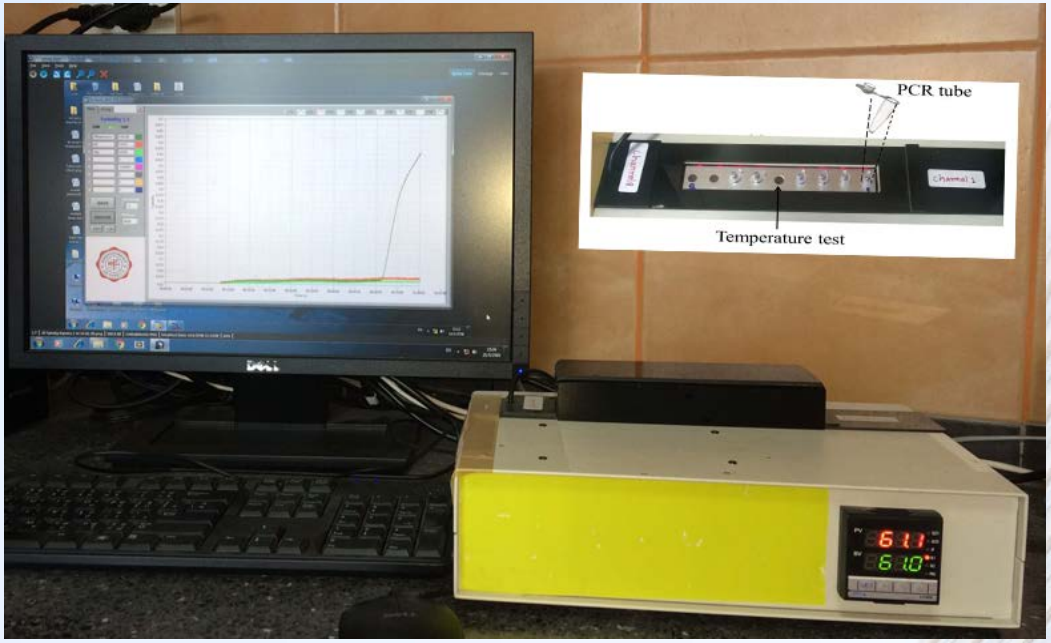
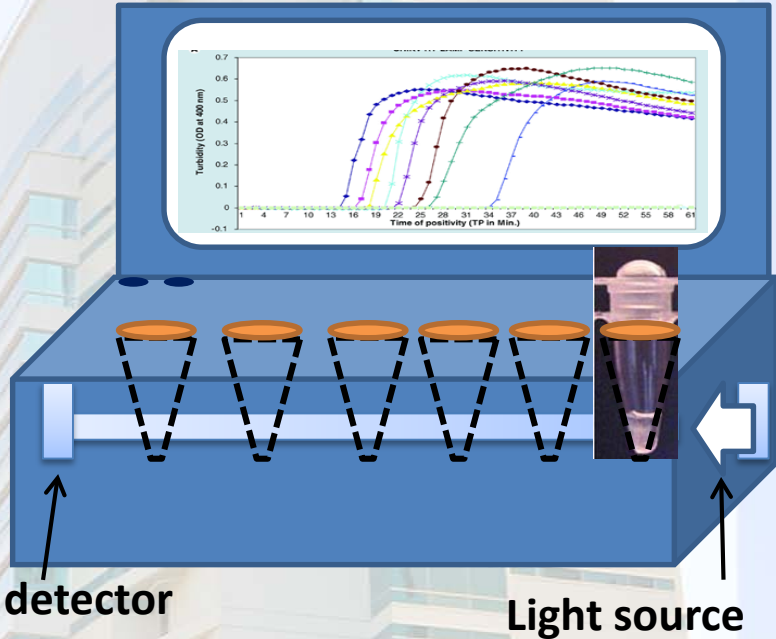


Peristal

Kaewphinit T, et al. (2013). Chapter 9: Quartz Crystal Microbalance DNA Based Biosensors for Diagnosis and Detection: A Review, Sensors and Biosensors, MEMS Technologies and its Applications, Advances in Sensors : Review, Vol.2

Optical based biosensor

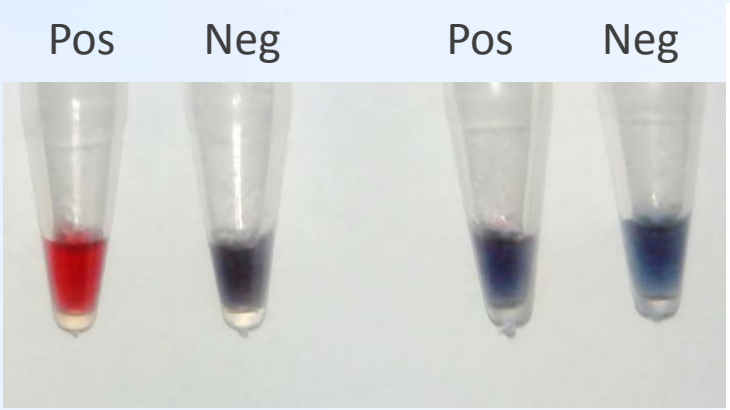


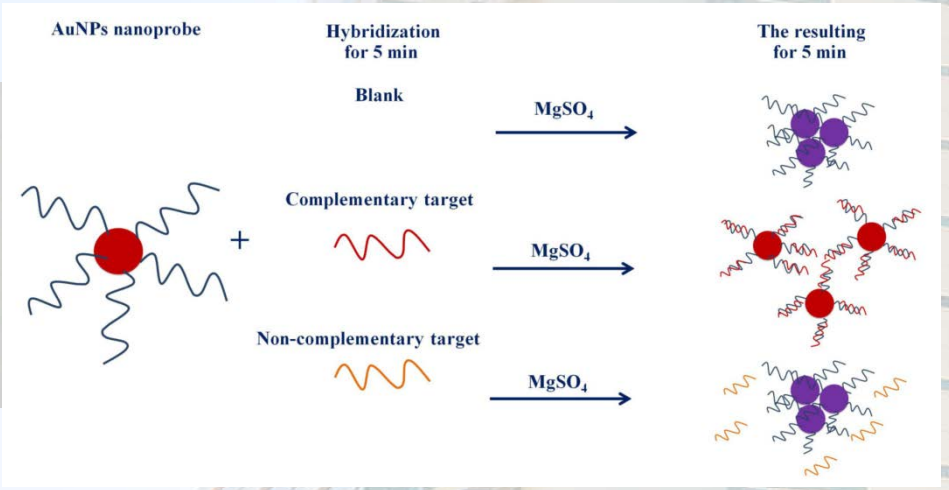


Ckumdee J, Santiwatanakul S, Kaewphinit T. (2017). Development of a rapid and sensitive DNA turbidity biosensor test for diagnosis of *katG* gene in isoniazid resistant M*ycobacterium tuberculosis*.
IEEE SENSORS,1 - 3

Colorimetric based biosensor

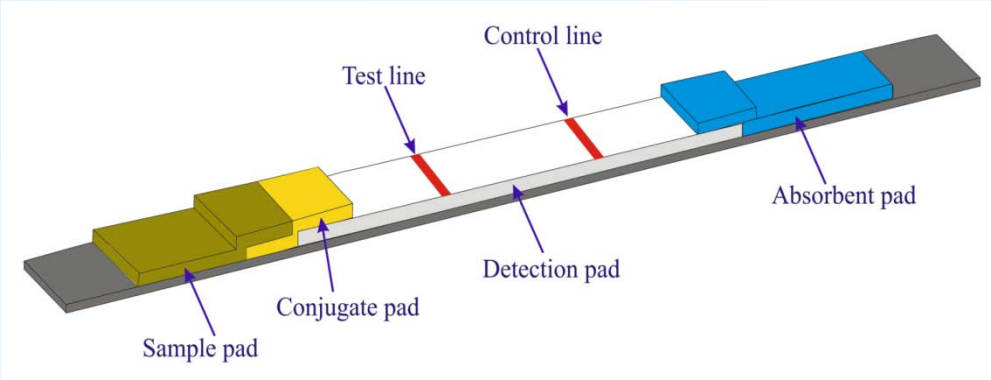
A *colorimetric* detection method using gold nanoparticle-functionalized visible *color changes* are easily observed

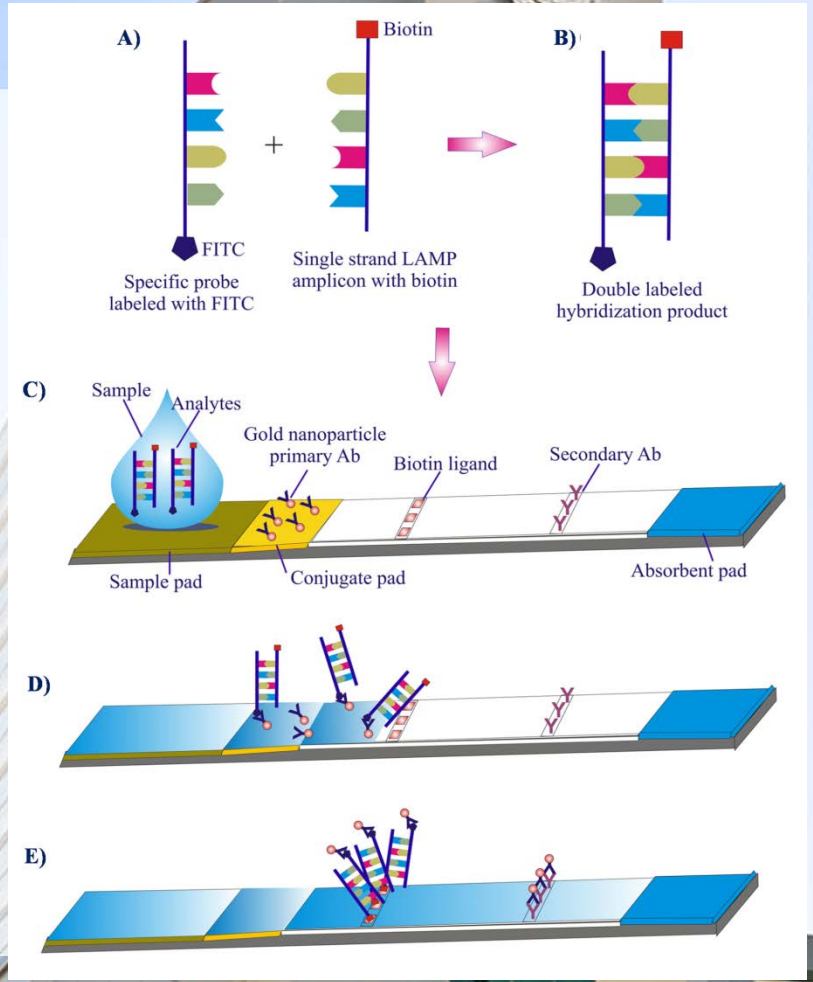




Kaewphinit, T.,Ckumdee, J., Chansiri, K., and S., Santiwatanakul. Development and Evaluation of a Loop-mediated Isothermal Amplification Combined with Au-nanoprobe Assay for Rapid Detection of *Mycobacterium tuberculosis*. Indian Journal of Medical Microbiology. 2017; 35(2):302-304

Lateral Flow based biosensor





Kaewphinit, T., S., Santiwatanakul and K., Chansiri. “The Detection of Tuberculosis by Loop-Mediated Isothermal Amplification (LAMP) Combined with a Lateral Flow Dipstick.” Handbook of Research on Diverse Applications of Nanotechnology in Biomedicine, Chemistry, and Engineering. IGI Global, 2015. 269-300. doi:10.4018/978-1-4666-6363-3.ch013

Biosensor applications

Medical

Infectious disease

- TB, MDR, XDR
- Lymphatic filariasis
- Heartworm
- Listeria
- Dengue fever virus
- Alzheimer's disease
- Group B Streptococcus
- Rickettsia
- Trypanosome
- Samonella
- Campylobacter
- HBV, HCV
- MRSA
- Chlamydia & Gonorrhea

Agriculture

-*Pineapple*

Mealybug Wilt associated Virus

- Rice contamination

Awards

- **International Invention Exhibition award 40 medals**
- National Research Council of Thailand (NRCT) **award**

-ชุดตรวจวัณโรคและวัณโรคดื้อยา รางวัลผลงานประดิษฐ์คิดค้นระดับดีมาก ประจำปี 2559

-ชุดดีเอ็นเอไบโอเซนเซอร์แบบแถบเพื่อใช้ในการตรวจวินิจฉัย เชื้อซัลโมเนล่าในผลิตภัณฑ์อาหาร รางวัลผลงานประดิษฐ์คิดค้นระดับเกียรติคุณ ประจำปี 2557

-ชุดการพัฒนาการวินิจฉัยการติดเชื้อวัณโรคชนิด *มัยโคแบคทีเรียม ทูเบอร์คูโลซิส* ด้วยดีเอ็นเอเซนเซอร์ รางวัลผลงานวิจัยระดับดีเยี่ยม ประจำปี 2556

-ชุด DNA biosensor สำหรับตรวจหาเชื้อวัณโรคชนิด *Mycobacterium tuberculosis* รางวัลผลงานประดิษฐ์คิดค้นระดับดีเด่น ประจำปี 2555

- **Technology Licensing Office (Bioadvantech Co, Ltd.)**

  TB, MDR-TB (Rifampicin & Isoniazid)

- 14 patents

Tuberculosis (TB)

TB is an airborne infection caused by the *Mycobacterium tuberculosis* (MTB) bacteria. World Health Organization (WHO) described that TB is a persistent difficulty in developing countries and ranks as the second leading cause of death from an infectious disease worldwide after the human immunodeficiency virus (HIV)

Epidemiology

WHO reported 6.3 million new cases of TB in year 2016.

Millions of people are diagnosed and successfully treated for TB each year, averting millions of deaths (53 million 2000–2016)

1945

TB in THAILAND

The country with a population of nearly 64 million, with about 93,000 new cases each year and smear positive TB prevalence by about 16% of the nearly 130,000 people who are also HIV positive.

แผนยุทธศาสตร์ระดับชาติ ปี 2558-2562

ค้นให้พบ จบด้วยหาย
พัฒนาเครือข่ายและระบบดูแล

เพื่อลดการป่วย ลดการตาย การขาดยา
และป้องกันเชื้อดื้อยา

“วัณโรค” ปัญหาระดับชาติ

ความคุ้มค่ากับการรักษา

วัณโรค 2,600-6,000 บาทต่อราย เวลา 6-9 เดือน

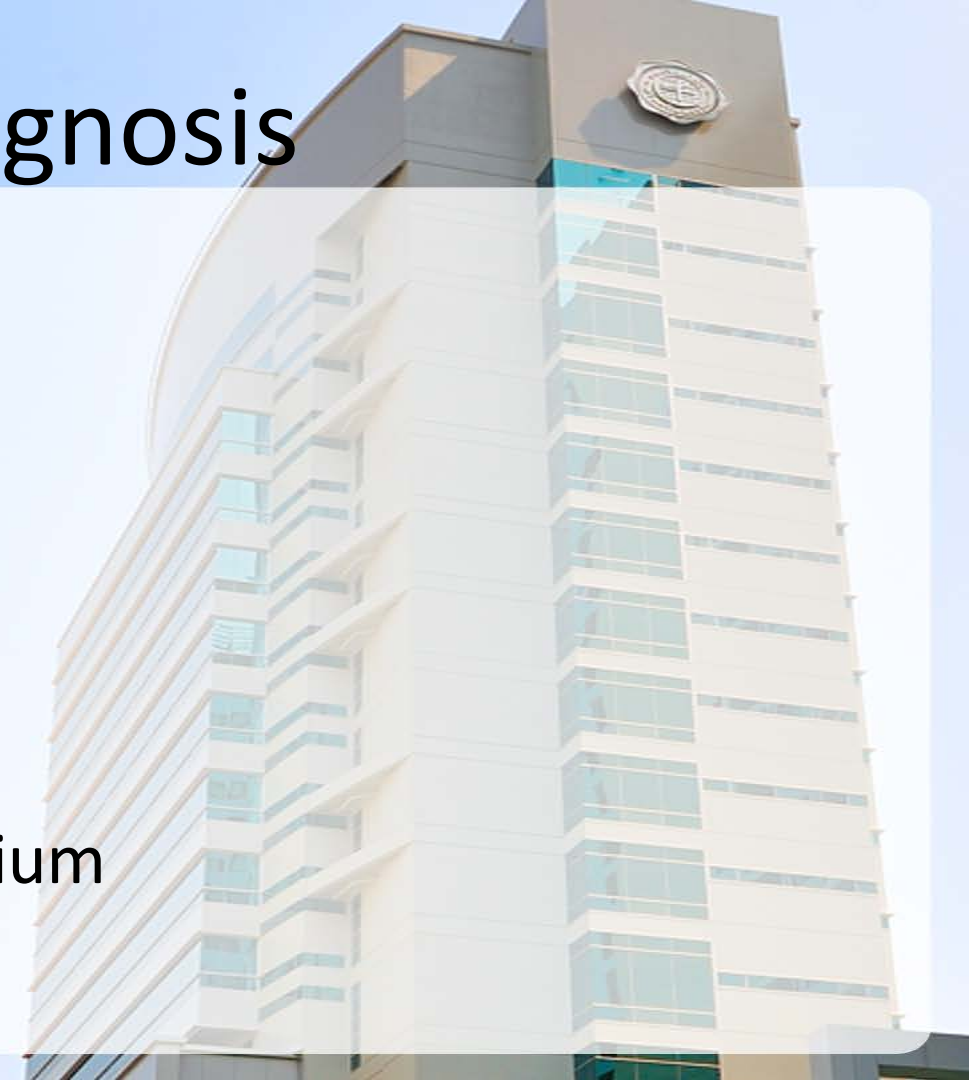
วัณโรคดื้อยา 200,000 บาทต่อราย เวลา 12-18 เดือน

วัณโรคดื้อยารุนแรง 1-2 ล้านบาทต่อราย เวลา18-24 เดือน

หากไม่ได้รักษาให้กับผู้ป่วยเหล่านี้ มีโอกาสที่เชื้อวัณโรคดื้อยาจะมีการแพร่กระจายไปสู่ประชาชนเพิ่มมากขึ้น

Laboratory TB diagnosis

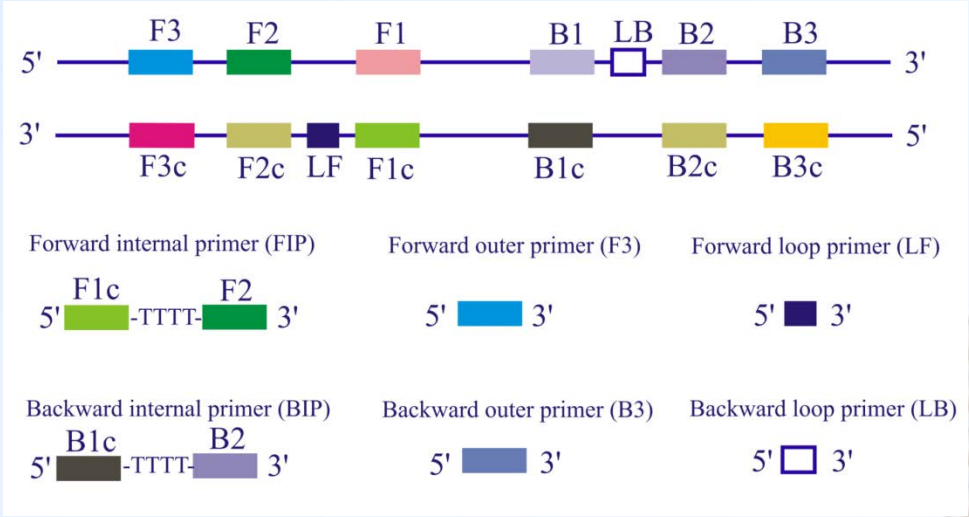
- Cultivation
- AFB smear
- Molecular methods
  - PCR & Real time PCR
  - Genexpert
  - GenoType Mycobacterium

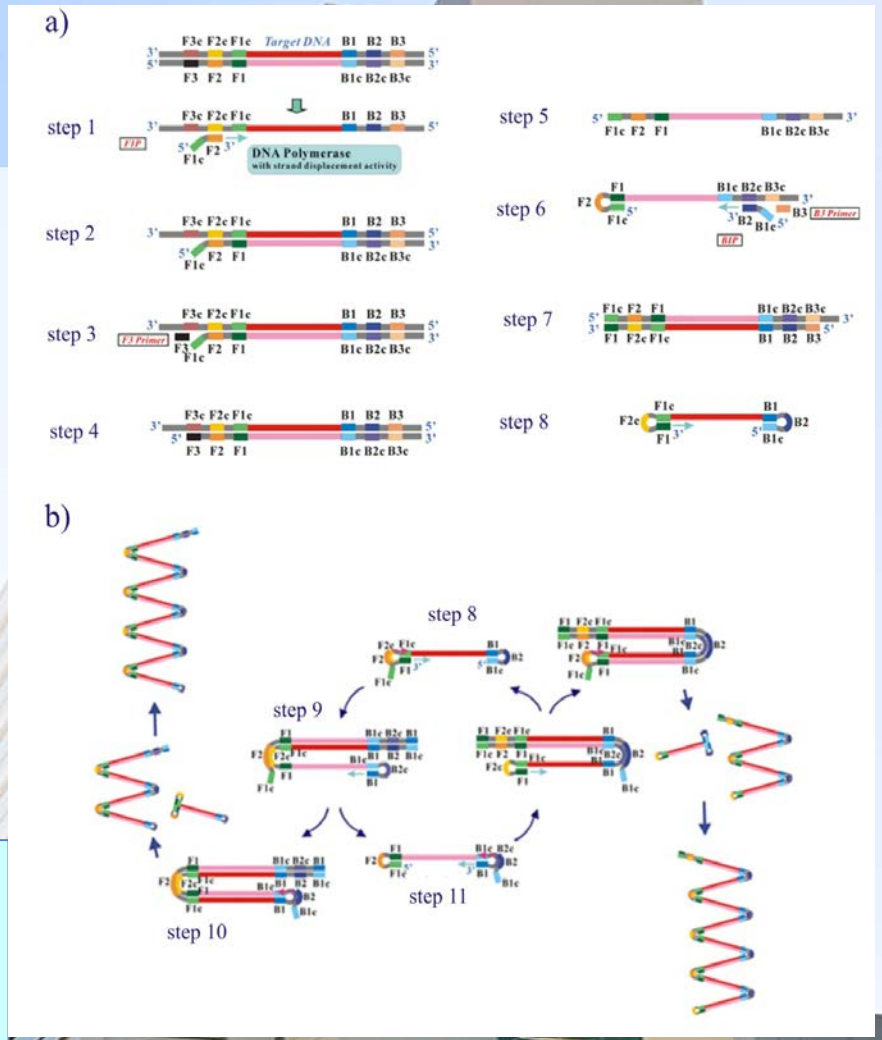


LAMP

Novel developments in molecular diagnostic techniques have demonstrated the possibility of DNA amplification under isothermal conditions, without thermal cycling. These method can amplify DNA termed loop-mediated isothermal amplification (LAMP) by high specificity, efficiency and rapidity under isothermal condition.

LAMP





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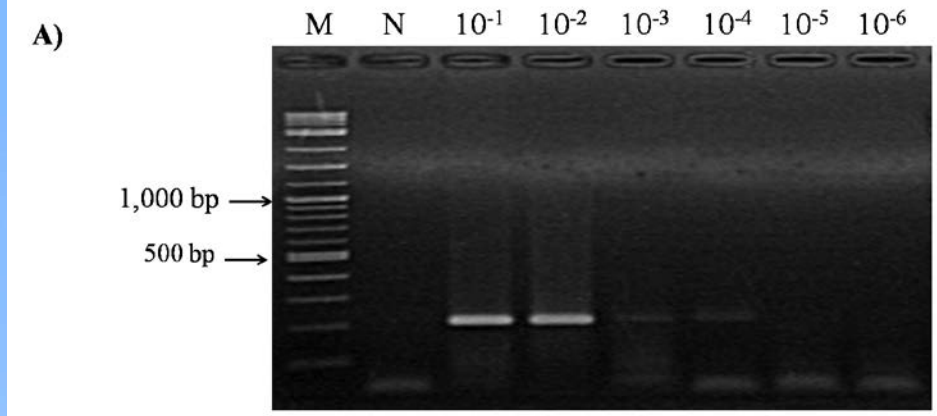
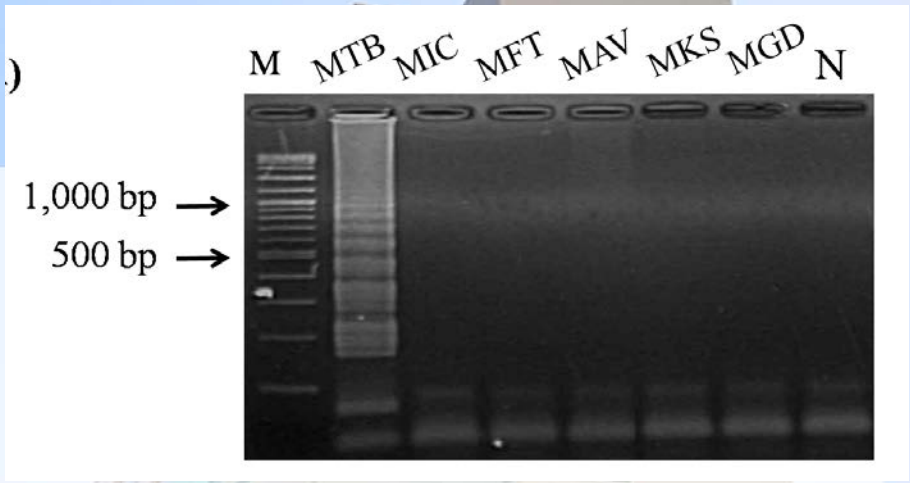
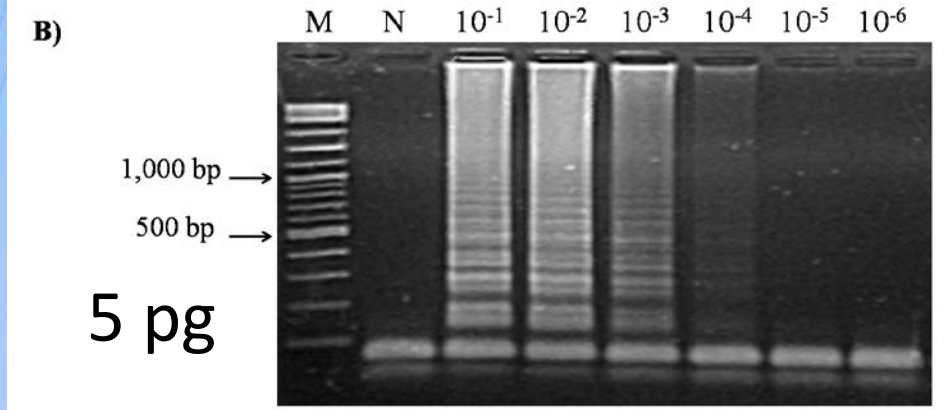






5 pg

M. tuberculosis (MTB),
M. intracellulare (MIC),
M. fortuitum (MFT),
M. avium (MAV),
M. kansasii (MKS), and *M. gordonae* (MGD).

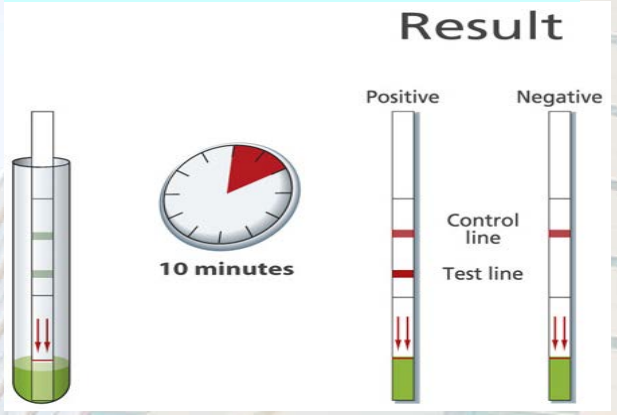
Kaewphinit T., Arunrut N., Kiatpathomchai W., Santiwatanakul S., Jaratsing P., Chansiri K. (2013). Detection of Mycobacterium tuberculosis by using loop-mediated isothermal amplification combined with a lateral flow dipstick in clinical samples. Biomed Research International, Volume 2013 , Article ID 926230. http://dx.doi.org/10.1155/2013/926230.

Our method

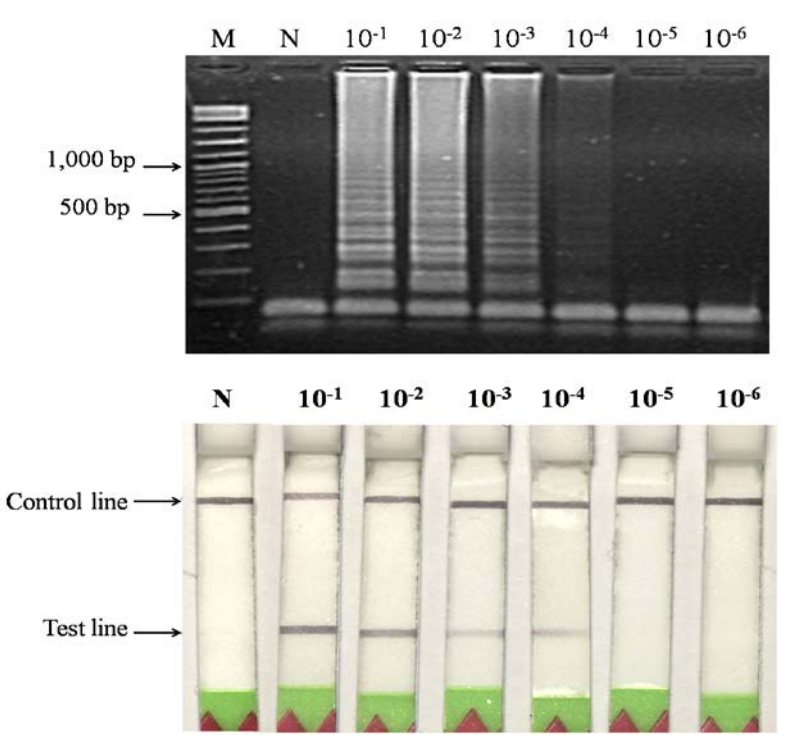
High sensitivity and specificity

+

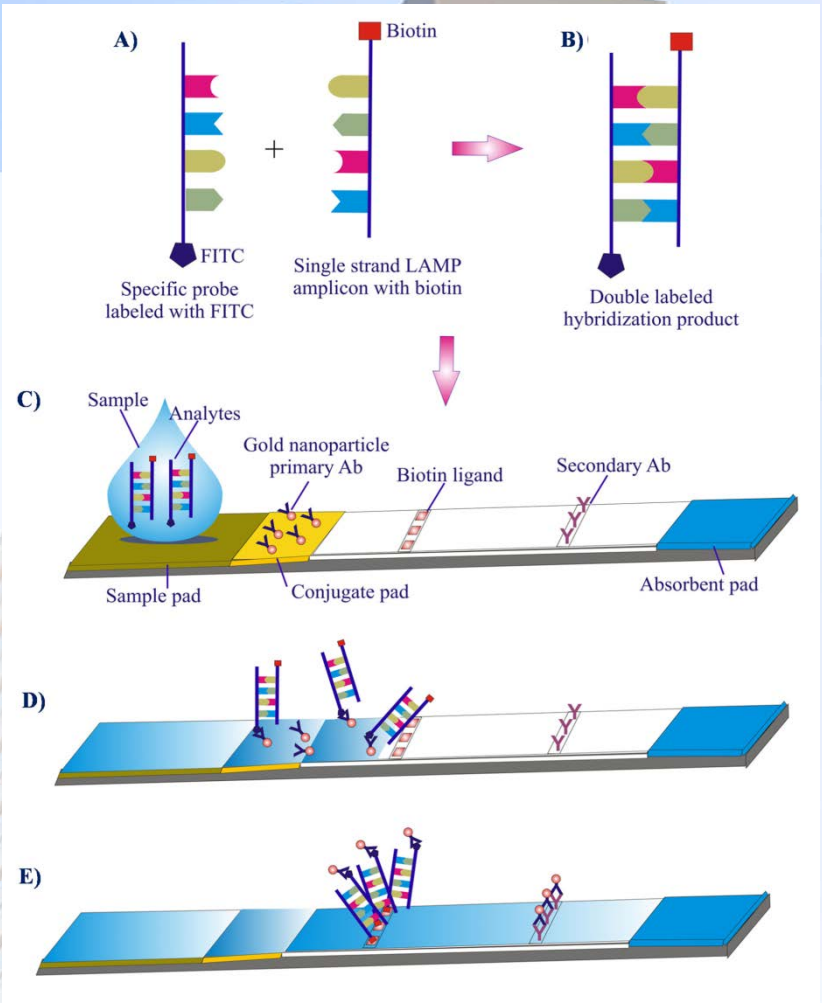
Rapid, ease to use

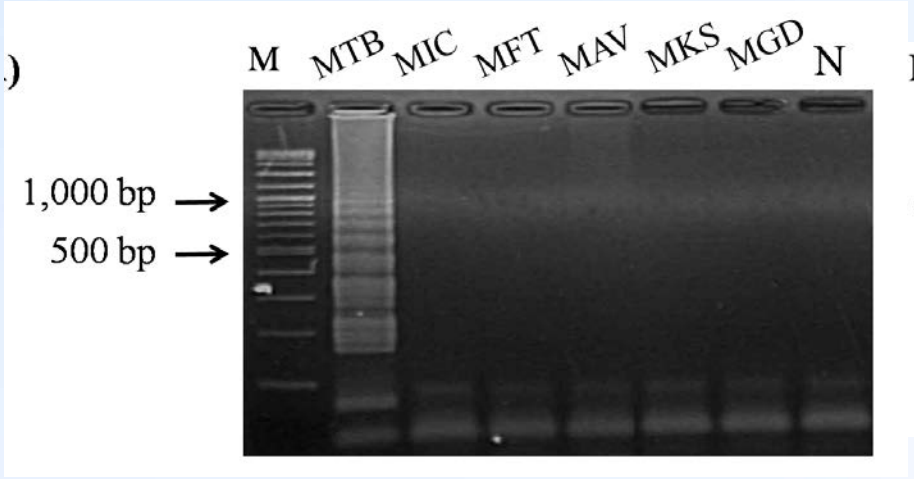


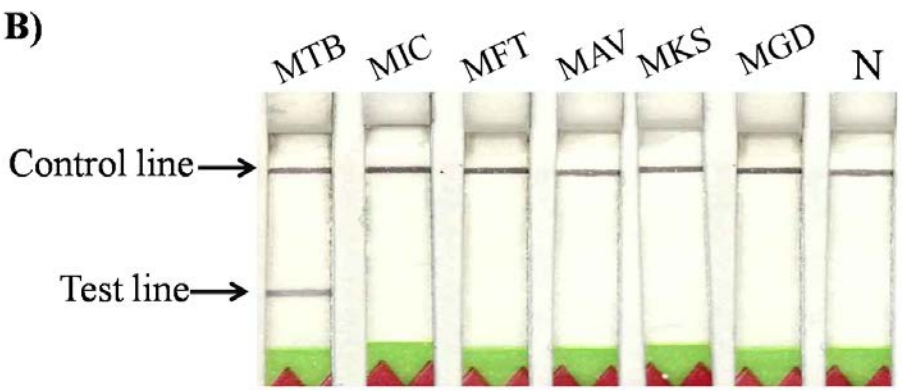
Lateral flow for TB



5 pg of genomic DNA target



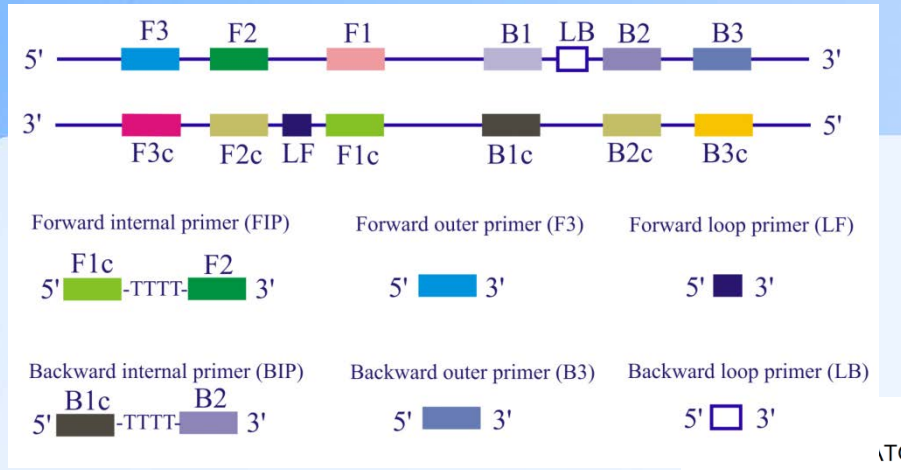




Kaewphinit T., Arunrut N., Kiatpathomchai W., Santiwatanakul S., Jaratsing P., Chansiri K. (2013). Detection of Mycobacterium tuberculosis by using loop-mediated isothermal amplification combined with a lateral flow dipstick in clinical samples. Biomed Research International 926230,http://dx.doi.org/10.1155/2013/926230.

MDR-TB

Primer design



Ckumdee, J., Kaewphinit, T., Chansiri, K., and S., Santiwatanakul. Development of Au-nanoprobes combined with Loop-mediated isothermal amplification for detection of Isoniazid resistance in *Mycobacterium tuberculosis*. Journal of chemistry. 2016:3474396.

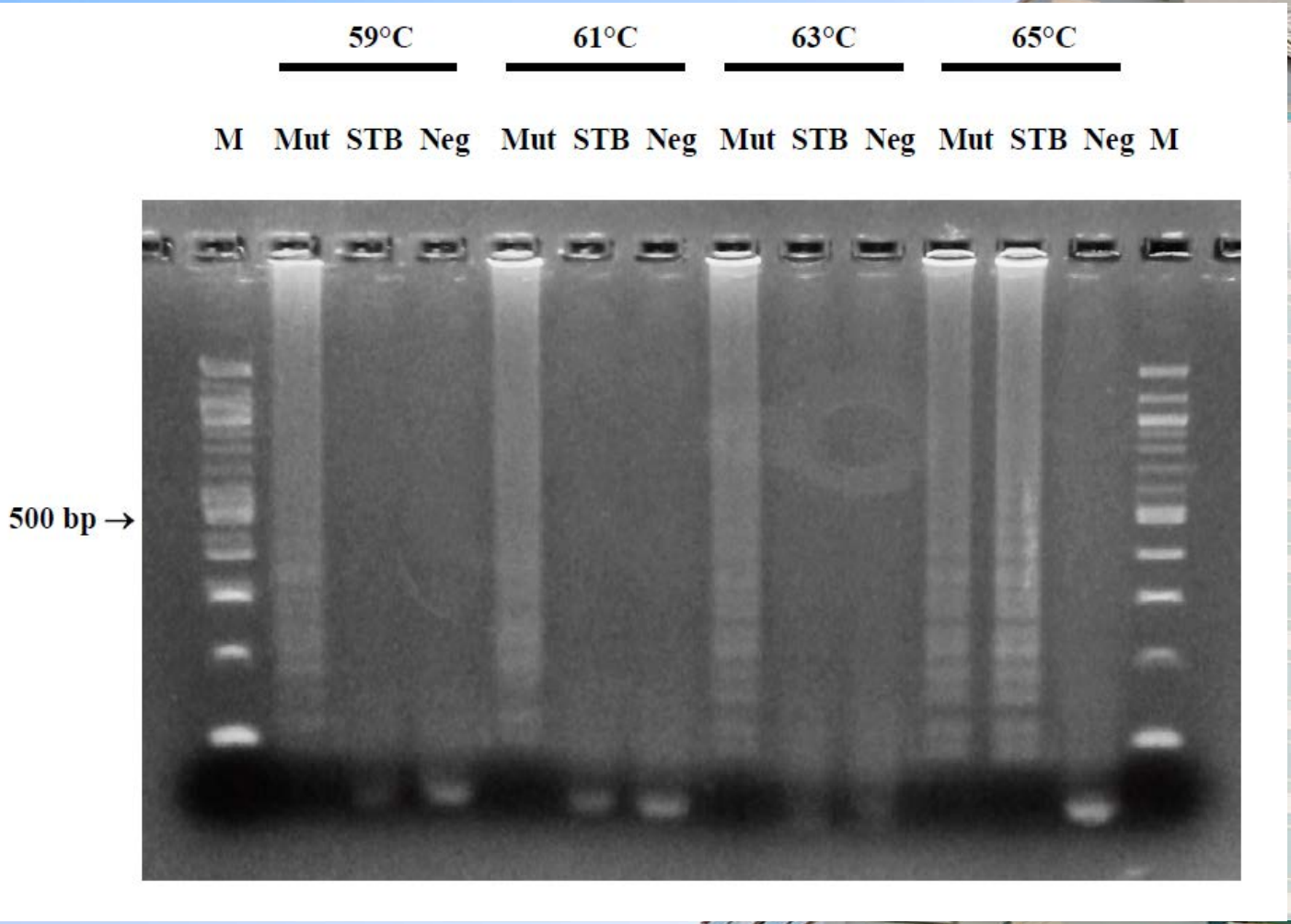
TGGCCGCGGCGGTCGACATTCGCGAGACGTTTCGGCGCATGGCCATGAACGACGTCGA

2761 AACAGCGGCGCTGATCGTCGGCGGTCACACTTTCGGTAAGACCCATGGCGCCGGCCCGGC
F3-*katG*→

2821 CGATCTGGTCGGCCCCGAACCCGAGGCTGCTCCGCTGGAGCAGATGGGCTTGGGCTGGAA

2881 GAGCTCGTATGGCACCGGAACCGGTAAGGACGCGATCACCA(**G/C**)CGGCATCGAGGTCGTATG
F2-*katG* → ←F1C-*katG* B1C-*katG*→
GGCCGTAGCTCCAGC
*katG*315MTprobe

2941 GACGAACACCCCGACGAAATGGGACAACAGTTTCCTCGAGATCCTGTACGGCTACGAGTG -3'
← B2-*katG* ←B3-*katG*


59°C
61°C
63°C
65°C
M Mut STB Neg Mut STB Neg Mut STB Neg Mut STB Neg M
500 bp →


R
I
R+I
MDR-TB
TB

Commercialized product

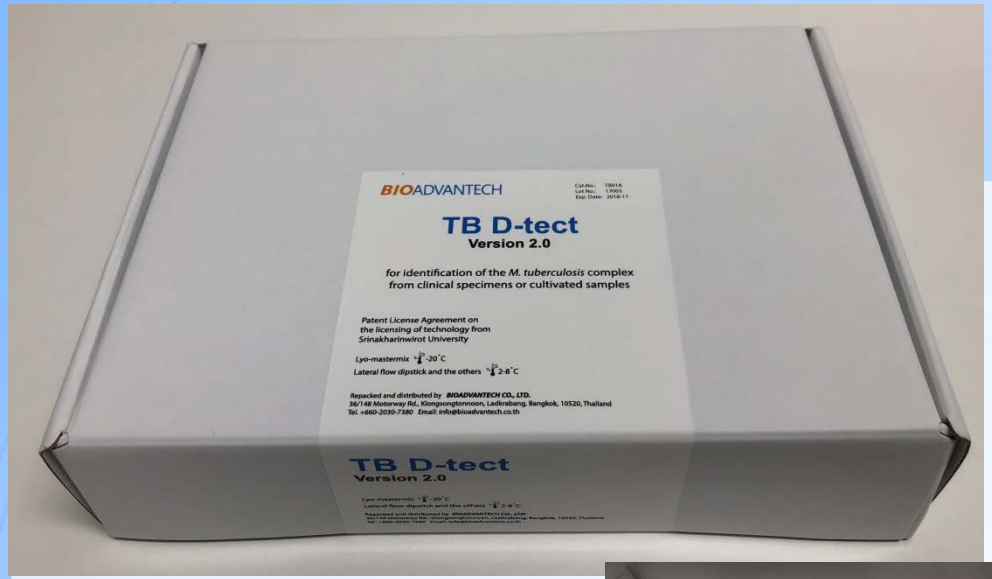
https://www.youtube.com/watch?v=mS1zgd2HDVk

ถ่ายทอดเทคโนโลยีสู่เชิงพาณิชย์

มหาวิทยาลัยศรีนครินทรวิโรฒ

ถ่ายทอดเทคโนโลยี “ชุดตรวจวัณโรคและวัณโรคดื้อยา”

ให้แก่ **บริษัท ไบโอแอดแวนเทค จำกัด**


BIOADVANTECH
TB D-tect
Version 2.0
for identification of the M. tuberculosis complex
from clinical specimens or cultivated samples
Patent License Agreement on
the licensing of technology from
Srinakharinwirot University
Lyo-mastermix -20°C
Lateral flow dipstick and the others 2-8°C
Repacked and distributed by BIOADVANTECH CO., LTD.
36/148 Motorway Rd., Klongsongtonnoon, Ladkrabang, Bangkok, 10520, Thailand
Tel. +660-2030-7380 Email: info@bioadvantech.co.th
TB D-tect
Version 2.0


No. A-TB
LYO-MASTERMIX
Cat.No.: TBLM1
Lot No.: 17003
Exp.Date: 2018-11
No. B-LATERAL FLOW
DIPSTICK TT
Cat.No.: TBST1
Lot No.: 17003
Exp.Date: 2018-11

TB D-tect


TBDR D-tect
Version 2.0


BIOADVANTECH
TBDR D-tect
Version 2.0
for identification of the M. tuberculosis complex
resistance to rifampicin and isoniazid
from clinical specimens or cultivated samples

TBDR D-tect

...making excellence a habit.™

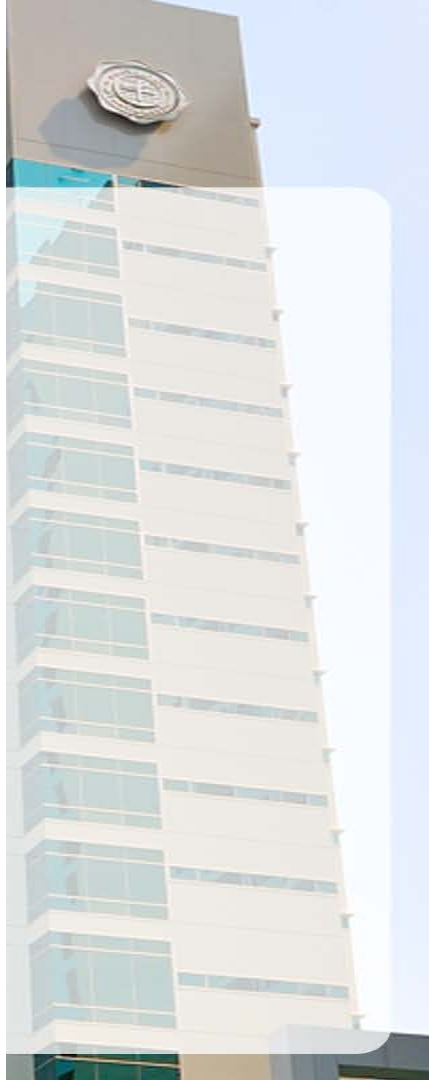
BIOADVANTECH CO.,LTD
36/148 Motor-way Road Klongsongtonnoon,
Ladkrabang, Bangkok 10520

Further to your ongoing business by ISO 9001:2015 & ISO13485:2016 certificate requested,BSI Group (Thailand) Co., Ltd. pleased to confirm that your Quality management systems , Medical devices is in progress of assessment preparation. We have received the signed agreement and now on process of registration.

The approval is going on certification scope: Manufacture of Medical Test Kit TB D-Tect Tuberculosis And TB DRD-Tect Tuberculosis of vehicle body for Industrial and Off-Highway vehicles (such as Crawler Loader, Motorgrader, Rough Terrain Crane and Vibratory Roller Compactor), by initial assessment scheme.

Regards,

Bookkhalakorn Chaidee (Mr.)
Sales Director
MB: 0865324271
Email : bookkhalakorn.chaidee@bsigroup.com



The agency certification by BUREAU OF TUBERCULOSIS

BIOADVANTECH

LOT NO. : TBAA100001
MFG. DATE: 18 MAY 2017
EXP. DATE: 17 MAY 2018

MINERAL OIL (No. D) 1.5ml. LOT NO.: MO017E18 MFG. DATE: 18MAY2017 EXP. DATE: 17MAY2018

DNA POLYMERASE TB (No. B) 50µl. LOT NO.: DP117E18 MFG. DATE: 18MAY2017 EXP. DATE: 17MAY2018

MASTER MIX TB (No. A) 1.0ml. LOT NO.: MM117E18 MFG. DATE: 18MAY2017 EXP. DATE: 17MAY2018

FITC TB (No. C) 25µl. LOT NO.: FC117E18 MFG. DATE: 18MAY2017 EXP. DATE: 17MAY2018

ASSAY BUFFER TB (No. E) 5ml. LOT NO.: AB117E18 MFG. DATE: 18MAY2017 EXP. DATE: 17MAY2018

TB D-tect
Version 1.0

LATERAL FLOW DIPSTICK 1T
BIOADVANTECH

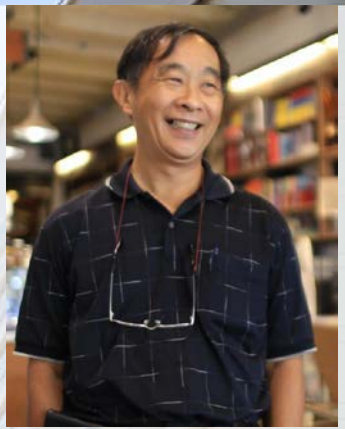
LOT NO.: DS117E18
MFG. DATE: 18MAY2017
EXP. DATE: 01MAR2018

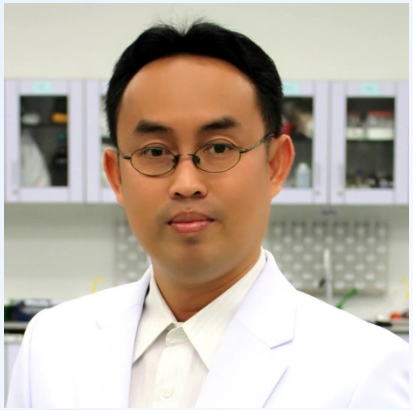
No.	ชนิดสิ่งส่งตรวจ	LAB No.	concentrate	ผลการตรวจ			
			smear	LPA	DST	TB detect ver.1	
1	เสมหะ(treated)	60-04935	1+	TB	TB	TB	
2	เสมหะ(treated)	60-04937	1+	TB	TB	TB	
3	เสมหะ(treated)	60-04940	1+	TB	TB	TB	
4	เสมหะ(treated)	60-04942	1+	TB	TB	TB	
5	เสมหะ(treated)	60-04944	1+	TB	TB	TB	
6	เสมหะ(treated)	60-04945	1+	TB	TB	TB	
7	เสมหะ(treated)	60-04946	2+	TB	TB	TB	
8	เสมหะ(treated)	60-04963	2+	TB	TB	TB	
9	เสมหะ(treated)	60-04980	1+	TB	TB	TB	
10	เสมหะ(treated)	60-04982	1+	TB	TB	TB	
11	เสมหะ(treated)	60-04983	1+	TB	TB	TB	
12	เสมหะ(treated)	60-04984	1+	TB	TB	TB	
13	เสมหะ(treated)	60-04985	1+	TB	TB	TB	
14	เสมหะ(treated)	60-04986	1+	TB	TB	TB	

The agency certification by BUREAU OF TUBERCULOSIS

No.	ชนิดสิ่งส่งตรวจ	LAB No.	concentrate smear	ผลการตรวจ			
				LPA	DST	TB detect ver.1	
34	เพาะเลี้ยงเชื้อ	60-05047	-	TB	TB	TB	
35	เพาะเลี้ยงเชื้อ	60-05048	-	TB	TB	TB	
36	เพาะเลี้ยงเชื้อ	60-05049	-	TB	TB	TB	
37	เพาะเลี้ยงเชื้อ	60-05050	-	TB	TB	TB	
38	เพาะเลี้ยงเชื้อ	60-05051	-	TB	TB	TB	
39	เพาะเลี้ยงเชื้อ	60-05052	-	TB	TB	TB	
40	เพาะเลี้ยงเชื้อ	60-05053	-	TB	TB	TB	
41	เพาะเลี้ยงเชื้อ	60-D2372	-	TB	TB	TB	
42	เพาะเลี้ยงเชื้อ	60-D2480	-	TB	TB	TB	
43	เพาะเลี้ยงเชื้อ	60-D2491	-	TB	TB	TB	
44	เพาะเลี้ยงเชื้อ	60-D2493	-	TB	TB	TB	
45	เพาะเลี้ยงเชื้อ	HE7RV	-	TB	TB	TB	
46	เพาะเลี้ยงเชื้อ	HE7RV	-	TB	TB	TB	
47	เพาะเลี้ยงเชื้อ	HE	-	TB	TB	TB	
48	เพาะเลี้ยงเชื้อ	HE	-	TB	TB	TB	
49	Reagent buffer.	buffer	-	-	-	-	
50	DW ของชุดทดสอบ	DW.	-	-	-	-	

คณะผู้วิจัย






Q&A