Team UNIST_Korea

Ee Seul, Shin  
Jae Sung, Yoo  
Bo Keun, Song

Yu-Lim, Lee
Risk of accidental escape

Risk of open test in environment

Risk of deliberate misuse
Although there are many self-lysis devices, they didn’t concern DNA degradation.

UNIST_KOREA Team designed Novel programmed cell death device that chops up DNA.
Goal

Sense the environment

Implement novel DNA degradation kit.
Whole Scheme

- Dark
- Lots of nutrition
- Higher temperature
- Uniform QS

- Light
- No nutrition
- Lower temperature
- Foreign QS

Fermentor

Environment

Works!

BOOM!!!
Sensor Module

High Sensitivity

Light receptor

Temperature sensor

Cph1

EnvZ

P

AHL

Quorum Sensing Molecule
Processor Module

Lambda CI System

fim Inversion System

Tight Regulation
Lysis Module

Cell lysis

DNA degradation

High Performance

BOOM!!!
Construction of *Chop. coli*

Sensor Module

Processor Module

Lysis Module
Light signal system

Temperature signal system

Quorum sensing system
**Chop coli** prefers darkness over light
Sensor Module: Light

Signal transduction
Darkness represses the gene expression
Sensor Module: Light

Opaque

Transparent
High concentration of sugar represses the gene expression.
High concentration of sugar represses the gene expression.

![Graph showing relative fluorescence over cultivation time with different sugar concentrations.](image-url)
Light signal system

Temperature signal system

Quorum sensing system
Sensor Module: Temperature

Riboswitch

37°C
Sensor Module: Temperature

Relative mRNA level 37°C/27°C

Protein synthesis at 27°C and 37°C (AU)

Olga, Cell (2011)
High temperature repress the gene expression.
Light signal system

Temperature signal system

Quorum sensing system
Sensor Module: Quorum Sensing
To prevent the leaky expression

To avoid undesired cell death during inoculum preparation
cl control system

FimE inversion system
Processor Module: CI control

Darkness

Cph1

EnvZ

P

OmpR

RNAP

RBS

CI

OmpC (+)

Transcription is blocked!
Processor Module: CI control

Transcription begins!
CI control system can switch ON gene expression with 1h duration time
cl control system

FimE inversion system
Lysis Module

Sensor Module

Processor Module

Lysis Module
Lysis Module

Lytic cassette

Holin cassette
Causes cell lysis

Dpn cassette
Chops up genetic material
Lysis Module: Cell lysis

Holins

Chop coli
Lysis Module: Cell lysis

Boom!!

Chop coli

Holin

Endolysin

Boom!!
Cell lysis, but DNA remnants
Cell Lysis Module

DNA Degradation Module
Lysis Module: DNA degradation
DNA is chopped, but no cell lysis
Chop coli

Light ON & Low temperature
Cell lysis & No DNA left
Light
Temp.
QS — search for universal QS on progress

fimE
cl

Holin & Dpn
— need to optimize expression
Combine the temperature, light and quorum sensing signal with the lysis circuit
Future Work

AHL

Lytic Cassette

Lysis!
Combine the temperature, light and quorum sensing signal with the lysis circuit

Industrially used microbes will have the lysis circuit
Essential for genetically modified microbes

As much important as promoter or gene

Reduces the fears around GMOs

One best way to support Synthetic Biology
When synthetic microbes are to be used in environment, they should carry the programmed cell death system to avoid risks.
Prevention is better than cure!!
Media Attention
We published an article in Korean language to introduce synthetic biology and iGEM competition to all universities in Korea.
Acknowledgement

Dr. Sung Kuk, Lee

Dr. Cheol-Min, Ghim

Dr. Yoon-Kyoung, Cho
Thank you