Blue Sensor Modeling Abstract

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2014 年 7 月 24 日

1 Background Knowledge

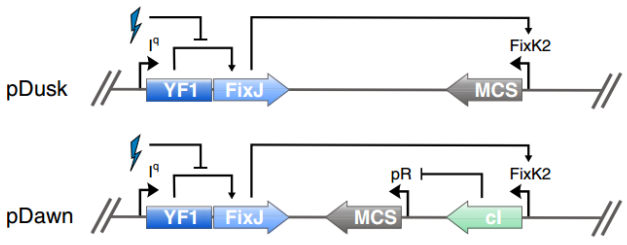
Ref: From Dusk till Dawn: One-Plasmid Systems for Light-Regulated Gene Expression

We establish as novel opto-genetic tools the plasmids pDusk and pDawn, which employ blue-light photo-receptors to confer light-repressed or light-induced gene expression in Escherichia coli with up to 460-fold induction upon illumination.

Because in our iGEM project we want a light-induced one, so we focus on pDawn's functionality in the following paragraphs.

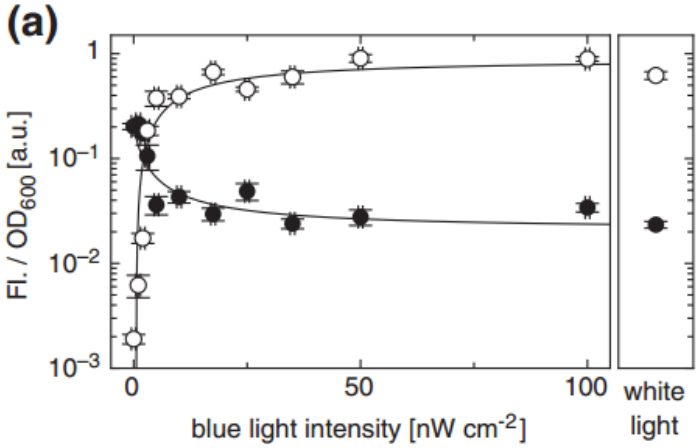
In the absence of blue light, YF1 phosphorylates its cognate response regulator FixJ, which then drives robust gene expression from the FixK2 promoter. Upon light absorption, net kinase activity of YF1 and consequently gene expression are greatly reduced.

The passway is like that:



In pDawn, the YF1/FixJ TCS drives expression of the λ phage repressor cI from the pFixK2 promoter, which, in turn, represses expression from the strong λ promoter pR.29 Again using DsRed as the reporter, gene expression is greatly enhanced with increasing blue-light intensity by a specific factor which we know numerically. That is, introduction of the inversion cassette not only inverted but also greatly amplified the effects of blue light.

The effect is like that:



In our iGEM project, we will choose PlacI as the constant promoter of TCS, with parts as downstream like that, finally trigger the expression of BFP.

2 Modeling

2.1 Abstract

The passway is direct. So we can directly use Hill equations to model this section.

Because I may make some mistakes in writing down the details, I will not provide every detail in equations. And because I am too lazy, I will not provide definitions temporarily.

2.2 Defination

NULL

2.3 Equations

1. YF1:
$$C_{YF1} = (K_{Ip} - Kdeg_{YF1})t$$
2. Valid YF1 (I have a problem here, so I use unknown function here):
$$C^*_{YF1} = F(C_{YF1}, Intensity_{blue})$$
3. FixJ:
$$C_{FixJ} = (K^*_{lp} - Kdeg_{FixJ})t$$
4. The represssing effect of valid YF1:
$$K^*_{lp} = \frac{K_{Ip}}{1 + \frac{Kdc}{C^*_{YF1}}}$$
5. The activation effect from FixJ on FixK2: *Hill equation for activator*
6. The lambda repressor cI and it's corresponding strong promoter: *The cI is produced as downstream of promoter FixK2, and then we have Hill equation for repressor*
7. final reporter: *The lambda promoter starts the downstream production of BFP*