

# FUNDING PROGRAM FOR NEXT GENERATION WORLD-LEADING RESEARCHERS

**Project Title:** Synthetic biology approaches to new understandings of gene expression network

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## 1. Background of research

My research interest is gene expression. Until now I have been describing how gene expression profiles change in response to environmental cues. In this work, on the other hand, I would like to create novel systems or new tools to gain insights into gene expression mechanisms. This work consists of three independent projects: 1. Design and synthesis of cell patterns, 2. Development of a tracking method of transcription history, 3. Reconstruction of the transcriptional ripple effect.

## 2. Research objectives

The project 1 aims at creating various gene expression patterns among the cells. The neighboring cells will mutually upregulate or downregulate each others' transcription, resulting in self-organized gene expression patterns. The project 2 aims at creating a tool to investigate which genes were transcriptionally active in the past. The project 3 aims at artificially causing the transcriptional ripple effect (a phenomenon where intensive transcription at one locus often leads to co-upregulation of the neighboring loci).

## 3. Research characteristics (incl. originality and creativity)

1. Through actually constructing gene expression networks in the dish, we will understand how cell patterns are formed in multicellular organisms. 2. The tracking method of transcription history will be an ideal tool to investigate the gene expression profiles in the reprogramming process (because the reprogramming efficiency is generally lower than 1%, and because we can not tell which cell will become iPS cells in the future). 3. The artificial ripple effect will contribute to the understanding of its molecular mechanism.

## 4. Anticipated effects and future applications of research

1. I would like to establish the experimental procedures to create gene expression networks, which will contribute to the basic technology of synthetic biology. 2. The tracking method of transcription history will be applicable to a broad range of biological experiments. 3. The effect of transcription on the neighboring genes is an important information to create genetically modified animals.