Luciferin-Luciferase Based Biosensor "Protocell" System

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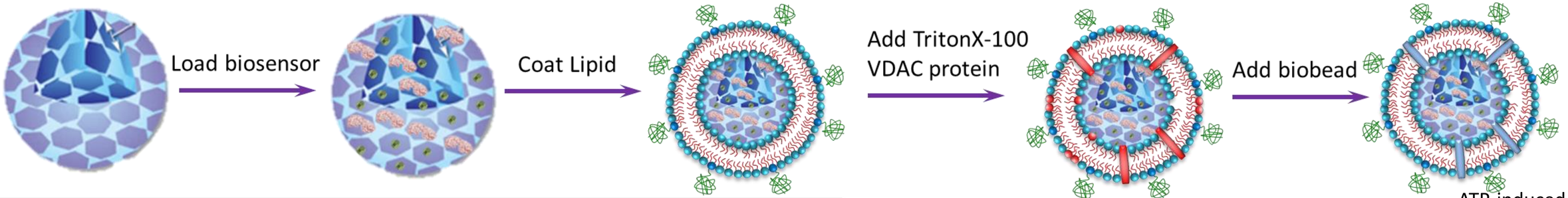
PROBLEM

Synthetic biology is an emerging field whose overall goal is to understand life processes using an engineering approach. However, current top-down synthetic biology approaches have limitations for the understanding of the fundamental molecular regulations since the host organisms have a complex and undetermined molecular composition.

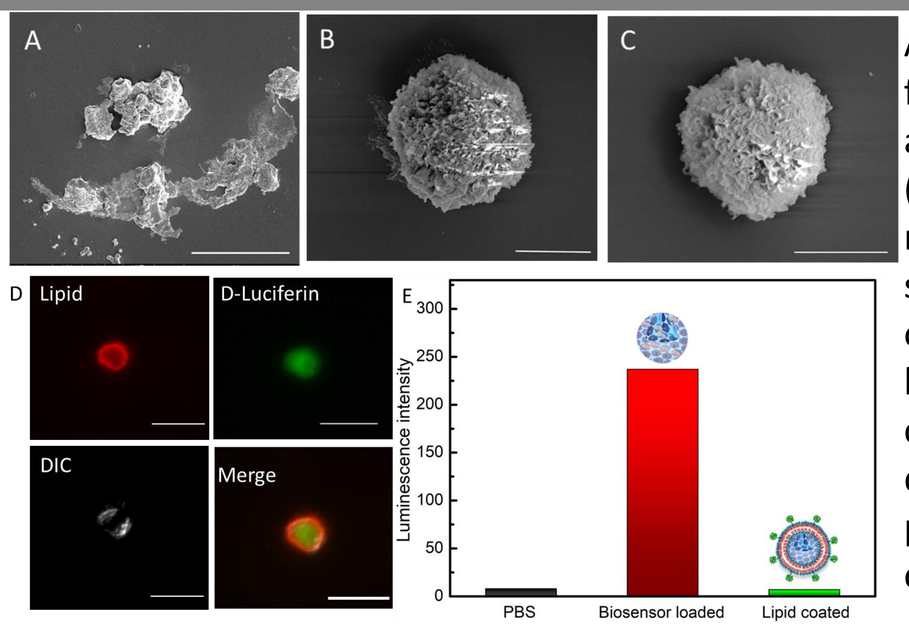
GOAL

We propose a complementary bottom-up approach to engineer "protocells". This "protocells" system will help us understand how cells respond to environmental signals. In the future, this will help us design and build engineered cell serving as a great tool to advance our understanding of the complex life processes.

METHODOLOGY

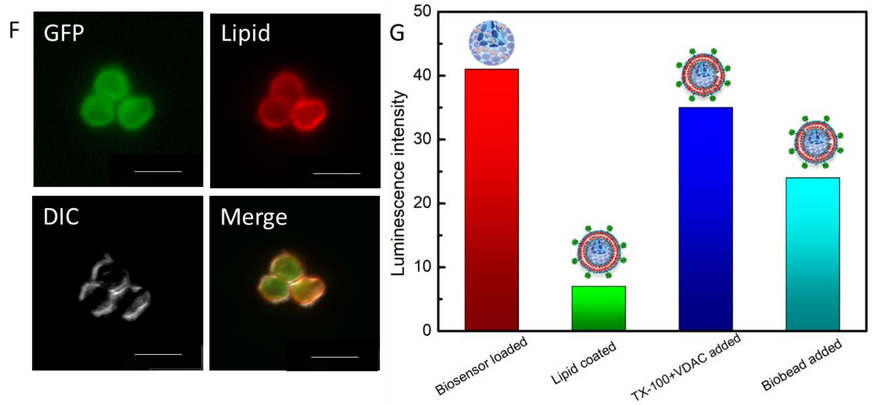


RESULTS



After silicifying the cells for 24 hours (Figure B) and calcinating the cells (also called silica cell replica, Figure C), the shape and morphology of these silica biocomposites are completely preserved during the silicification process and even after calcination.

ATP-induced luminescence tests were used to check the biosensor activities (Figure E). The biosensor loaded silica cell replica without lipid coating had a large luminescence jump after the addition of ATP, which indicates that biosensor loaded inside silica cell replicas can react as an enzyme system with extracellular ATP.



ATP-induced luminescence testing (Figure G) was used after each step towards making the mammalian cell mimic. We assume that only VDAC proteins are the only way for the ATP goes cross the lipid bilayer. Left B shows that our luciferin-luciferase based biosensor "protocell" system are working.

FUTURE WORK

- Optimize luciferin loading
- Further testing of controls and experiments to determine repeatability
- Try different types of ion channels to load onto lipid membrane
- Add more enzyme systems to cell replica, having multiple at once
- Try to make replica with a softer texture, closer to a mammalian cell