Researchers to develop active nanoscale surfaces for biological separations

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A team of researchers has received a four-year, $1 million grant from the National Science Foundation to study improved methods for biological separations. Led by Ravi Kane, the Merck Associate Professor of Chemical and Biological Engineering at Rensselaer Polytechnic Institute, the group plans to develop nanoscale surfaces that actively reassemble in the presence of DNA, which could eventually lead to more efficient separation tools for genomics and proteomics.

The researchers are taking their inspiration from nature, mimicking the very membranes that surround our cells to create platforms for separating biological molecules. These "lipid bilayers," which are made up of two opposing layers of fat molecules, act as the cell's barrier to the outside world. DNA molecules move on these surfaces in two dimensions, much like objects on a conveyor belt. Kane and his colleagues recently discovered that the mobility of DNA molecules is closely coupled to the movement of the underlying lipid bilayer.

"The advantage of these surfaces is that they can be actively modified," Kane said. "Thus by changing the temperature, shining light, or applying an electric field, we propose to change the behavior of the surfaces." In one approach, Kane and his colleagues are building a molecular obstacle course made up of nanoscale domains. When an electric field is applied at one end, DNA molecules will move across the surface and collide with the obstacles, impeding their motion. The researchers have already made surfaces on which they can control the size and positioning of obstacles; next, they plan to test the movement of DNA.

The overarching goal is to understand how biological molecules of all types move across the surface of lipid bilayers. "This particular project is focused on DNA, but the approach could potentially be used for separating other biological molecules, such as proteins," Kane said. He envisions immediate applications in genomics and proteomics, with the new approach providing several improvements over current techniques.

The new surfaces could yield separations with higher resolution and greater efficiency, Kane suggested. And they can be easily fabricated in a normal laboratory, whereas other surfaces require the use of a clean room. The nanoscale surfaces are also dynamic, while the materials in use today cannot be altered once they have been made.

In the more distant future, the surfaces could even be used as biosensors or to deliver DNA molecules for gene therapy applications, Kane said.

Source: Rensselaer Polytechnic Institute

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