



Engineering the Body's Defenses

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The immune system's ability to detect and counter infectious agents is among the body's most remarkable—and welcome—capabilities. Durable as this response may seem in the face of internal and external invasions, it is extremely intricate, and small disruptions can have large implications to the body's response.

However, the immune system sometimes needs help. Lance Kam seeks to improve immune response by combining cellular and molecular biology with technology adapted from the microelectronics industry. These techniques may one day allow doctors to retrain a patient's immune system to combat cancer, treat autoimmune diseases, and prevent transplant rejection.

Their research has shown that T lymphocytes, key regulators of the body's ability to recognize previous threats and adapt to new ones, respond in specific ways to patterns of proteins and other biomolecules they come in contact with. By recreating these patterns at a scale as fine as tens of nanometers, Kam's group, together with colleagues in an NIH-sponsored Nanomedicine Development Center, has been able to manipulate the activation of T lymphocytes to combat specific threats.

One of the threats of particular interest is cancer. A normally functioning immune system is able to weed out cancer cells that periodically arise in the body. Over time, people appear to lose that ability, making us more susceptible to cancerous mutations as we age. Identifying the patterns that produce cancer-fighting T lymphocytes would allow doctors to produce more of them and effectively retrain a patient's immune system to fight the disease naturally.

Kam directs Columbia University's Microscale Biocomplexity Laboratory, which focuses on understanding proper development, function, and repair of biological systems at scales of the intercellular level (tens of micrometers and hours) reaching down to those of supramolecular assemblies (tens of nanometers and milliseconds).

"Micro- and nano-scale systems have an ever increasing role in biomedical science and engineering," said Kam. "My research group focuses on the use of these systems to understand how cells read and respond to the complex presentation of cues in their extracellular environment.

"We focus particularly on the use of fabrication approaches, which offer a level of control over multiple spatial scales that is not possible through traditional molecular and self-assembly approaches; these are the scales at which cells operate and the realm of an increasing range of biological phenomena."

Kam did postdoctoral research in chemistry at Stanford University prior to coming to Columbia Engineering.

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