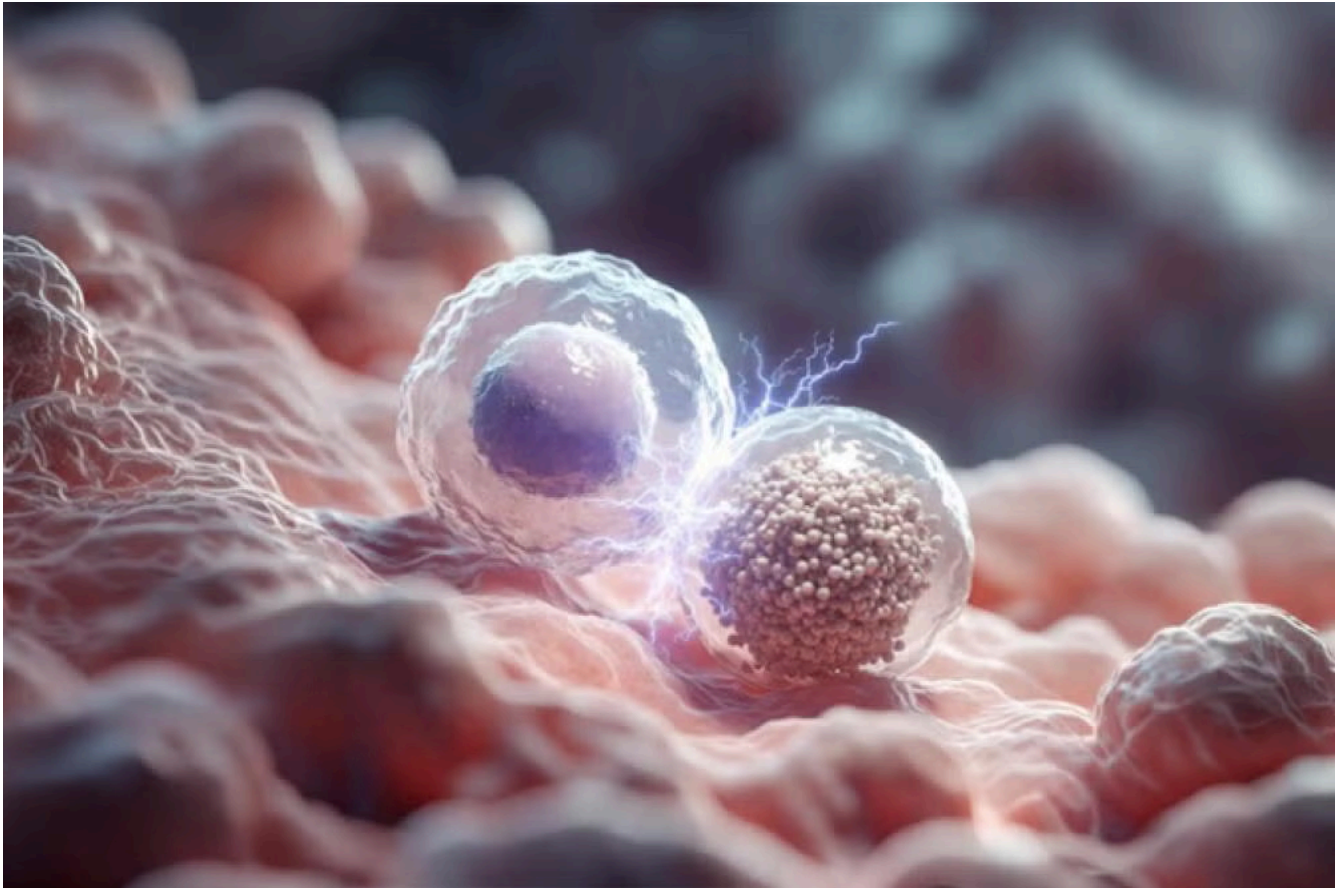


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A biomimetic microparticle designed to recruit and reactivate CAR-iNKT cells, helping sustain cancer-fighting activity. | Credit: Haochen Nan and Song Li/UCLA

Implantable “charging station” boosts fight against cancer

UCLA device sustains and recharges immune cells, improving their ability to attack both solid tumors and blood cancers

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Immunotherapy has transformed cancer treatment by harnessing the body’s own immune system to fight disease. But many engineered immune cells lose strength quickly after they enter the body, especially inside tumors that actively suppress immune activity. Researchers at UCLA have now developed an implantable device that acts like a support hub for these cells, helping them stay active and continue attacking cancer.

A study demonstrating the platform’s efficacy in human melanoma and lymphoma samples and laboratory cultures was published today in the journal **[Nature Biomedical Engineering](#)**.

Chimeric antigen receptor-invariant natural killer T cells, or CAR-iNKT cells, have shown promise in early studies, particularly against solid tumors that traditional CAR-T therapy struggles to treat. However, these cells often lose potency after delivery to a patient’s body. The UCLA team developed a system that functions like a charging station for these immune cells. Once implanted near a tumor, it attracts CAR-iNKT cells that have been engineered to recognize cancer.

At the heart of the approach are tiny biomimetic particles designed to mimic the activation signals for iNKT cells.

“These engineered microparticles are where CAR-iNKT cells recharge and switch back into attack mode,” said study co-leader **[Song Li](#)**, chancellor’s professor of bioengineering at the UCLA Samueli School of Engineering. “Instead of delivering a one-time boost, the device provides sustained signals that help the cells stay active, multiply and form long-term memory.”

The microparticles use a molecule called TCR antigen to reactivate the immune cells. They are also coated with capsules containing the signaling protein IL-15 that supports cell proliferation.

“It’s similar in concept to plugging your phone into a charging cable,” said study first author Yan-Ruide “Charlie” Li, a postdoctoral scholar of microbiology, immunology & molecular genetics at UCLA. “In this case, the CAR-iNKT cells connect to the TCR

antigen, which sets off a series of molecular signals that activate them, sending them back out to destroy cancer cells.”

In experiments, researchers noticed the effects were systemic: the recharged immune cells circulated in the bloodstream and killed cancer cells throughout the body.

“This approach significantly improves the durability and effectiveness of CAR-iNKT cell responses in both solid tumor and systemic blood cancer models, offering a new strategy to strengthen cell-based cancer therapies and expand their clinical potential,” said study co-leader [Lili Yang](#), a UCLA professor of microbiology, immunology & molecular genetics.

Designing the system required careful balance. Too much stimulation can exhaust immune cells, while too little support allows them to fade quickly. Researchers spent significant time optimizing the strength of the activation signals, the amount of growth-supporting protein released and even the physical properties of the material itself to maintain the right level of immune activity.

Equally important was keeping those signals localized. Previous strategies that relied on drugs or immune-stimulating proteins circulating throughout the body can trigger harmful side effects. By concentrating the signals in a small implanted site near the tumor, the new approach aims to support immune cells without exposing the entire body to high levels of immune-activating molecules.

In the preclinical study, the platform demonstrated promising biocompatibility. The team is continuing to refine the system and explore how it could support additional cancer immunotherapies.

At UCLA, Song Li and Lili Yang both hold faculty appointments with the Eli and Edythe Broad Center of Regenerative Medicine and Stem Cell Research and the [Jonsson Comprehensive Cancer Center](#). Yang also holds appointments with the Molecular Biology Institute, the Parker Institute for Cancer Immunotherapy and Goodman-Luskin Microbiome Center.

In addition to Charlie Li, UCLA bioengineering doctoral student Haochen Nan and then-assistant project scientist Zeyang Liu are co-lead authors of the paper. Liu is now an assistant professor at Peking University. Other authors on the paper include

UCLA bioengineering doctoral students Youcheng Yang and Xinyuan Shen; immunity, microbes and molecular pathogenesis doctoral students Ying Fang, Yichen Zhu and Yuning Chen; molecular and medical pharmacology doctoral student Zibai Lyu; and postdoctoral scholars Zhengyao Shao and Bo Zhang. [Tzung Hsiai](#), a UCLA Samueli bioengineering professor and a professor-in-residence at the David Geffen School of Medicine at UCLA, and assistant project scientist Enbo Zhu are also co-authors on the paper.

NOTES

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