PURDUE INNOVATES | Office of Technology Commercialization

# Nanoparticulate Vaccines for Small Molecules

**Nanoparticulate vaccines encapsulate small molecules to induce strong antibody responses, advancing treatments for opioid and drug abuse.**

Researchers at Purdue University have developed nanoparticulate vaccine candidates for small molecules that have great potential in medical application, for example, treating opioid abuse disorder and other drug abuse. Opioid abuse disorder is a major public health crisis in the United States, and opioid vaccines have the potential to induce opioid-specific antibodies that bind the drug and neutralize its biological effects. With the use of nanoparticulate vaccines, a shell can also carry pharmaceutical agents inside its core and deliver the treatment in human body. By utilizing this technology, vaccination against drugs of abuse can be scaled up and pave a new way of treatments for drug abuse.

**Technology Validation:**

The researchers exposed mice to nanoparticulate vaccines and obtained a heightened antibody response, obtaining increased response as the amount of small molecule target increased.

**Advantages**:

-Able to encapsulate protein at high efficiency

-Able to formulate nanoparticles with a high and tunable surface density of haptens of small molecules

-Scalable synthesis route

**Applications**:

-Treatments for opioid use disorder or neurotoxic agents

Publications:

**Technology ID**

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**Category**

Biotechnology & Life Sciences/Biomarker Discovery & Diagnostics
Materials Science & Nanotechnology/Nanomaterials & Nanostructures
Chemicals & Advanced Materials/Materials Processing & Manufacturing Technologies

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K. Ristroph, P. Rummaneethorn, B. Johnson-Weaver, H. Staats, and R. K. Prud'homme. "Highly-loaded protein nanocarriers prepared by Flash NanoPrecipitation with hydrophobic ion pairing." International Journal of Pharmaceutics (2021) DOI: 10.1016/j.ijpharm.2021.120397

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**TRL:** 4

**Intellectual Property:**

Provisional-Patent, 2024-08-20, United States

PCT-Patent, 2025-08-20, WO

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