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

2024-RIST-70348

Category

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

Authors

Brandi Johnson-Weaver
Kurt Ristroph
Herman Staats

Further information

Aaron Taggart
adtaggart@prf.org

View online page

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

Nicholas J. Caggiano, Satya K. Nayagam, Leon Z. Wang, Brian K. Wilson, Parker Lewis, Shadman Jahangir, Rodney D. Priestley, Robert K. Prud'homme, Kurt D. Ristroph,

Sequential Flash NanoPrecipitation for the scalable formulation of stable core-shell nanoparticles with core loadings up to 90%, International Journal of Pharmaceutics, Volume 640,

2023,122985, https://doi.org/10.1016/j.ijpharm.2023.122985.

Antigenâ€"Loaded Polymerâ€"Hapten Nanoparticles to Induce Small Molecule-Specific Antibodies. AIChE Annual Meeting 2024. https://aiche.confex.com/aiche/2024/meetingapp.cgi/Paper/691631

TRL: 4

Intellectual Property:

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

PCT-Patent, 2025-08-20, WO

Keywords: Drug abuse, Micro & Nanotechnologies, Nanoparticulate vaccines, Overdose, Pharmaceuticals