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DisruptTECH

From Biowaste to Rocket Fuel

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A person in a blue jumpsuit and green boots is working on a shelter made of silver and white tarps in a snowy forest. The shelter is built around a large log. The person is holding a rope or string. In the background, there are tall evergreen trees and a white tent-like structure. The ground is covered in snow and ice.

*Going to space is currently
a one-way camping trip...*

But even E.T. wanted to go home.

My Dream

Visit Mars

Enjoy visit

Return home

My Background

- Ph.D. (Synthetic Organic Chemistry, U Cambridge, UK)
- Postdoctoral Associate (Organocatalytic Polymers & DNA Nanotech; DNA Self-Assembly & Au-NPs, U Cambridge, UK)
- Visiting Professor in Origins of Chirality (U Nice Sophia Antipolis, France)
- Research Associate in Chiral Fullerenes (U Padova, Italy)
- Assistant Professor in Bio-Organic Chemistry (CSU Fullerton)

My Dream

Visit Mars

Enjoy visit

Return home

Current Interests

- Continuous Biocatalysis for Pharmaceutical, Environmental, & Propellant Solutions
- Automated Continuous Flow Synthesis & Self-Optimization of Pharmaceuticals & Fuels
- Chiroptical Characterization & Photodestruction of Small Molecules
- Microfluidic Syntheses/Analytics

Communications

Angewandte
International Edition
Chemie

Automated Synthesis

International Edition: DOI: 10.1002/anie.201809080
German Edition: DOI: 10.1002/ange.201809080

Across-the-World Automated Optimization and **Continuous-Flow Synthesis** of Pharmaceutical Agents Operating Through a Cloud-Based Server

Daniel E. Fitzpatrick, Timoth Maujean, Amanda C. Evans, and Steven V. Ley*

*"And if you solve
enough problems, you
get to come home."*

-The Martian

40

years

HYDRAZINE

Standard Rocket Fuel

- 🚀 Highly toxic & carcinogenic
- 🚀 Highly flammable
- 🚀 Expensive storage, handling & disposal

100,000 metric tons manufactured annually

Market cost of Ultra Pure Hydrazine = \$85-100/lb.

**Safety cost for fueling satellites =
>\$100,000/launch**

Green Rocket Fuel

HAN
50%
more **EFFICIENT**

>\$500K
SAVINGS
per launch

HYDRAZINE

HAN

STORABILITY

Low

High

TOXICITY

High

Low

PROPULSION
PERFORMANCE

Moderate

High

ENERGY DENSITY

Moderate

High

NASA GPIM Investment \$65 million

HAN and more...

HAN

H₂O

Ammonia

CO₂

\$76.64B
by 2025

Continuous ON-DEMAND manufacturing in space is ESSENTIAL

The Process

Provisional Patent LANL

Rocket fuel market

\$4.23B
in 2018

8.5%
by 2023

ROCKET FUEL MARKET

Hydrazine

Methane

HPGP

HAN

Go to market timeline

Prospective Partners

BLUE ORIGIN

ULA

AEROJET
ROCKETDYNE

Raytheon

Lonza

SPACE TANGO

SPACEX

GALACTIC

Orbital ATK

SPACEPORT
AMERICA

U.S. AIR FORCE

ISS

U.S. NATIONAL LABORATORY

The **first** photograph of Earth from space was taken over **New Mexico** in October of 1946. How inspiring and appropriate that the state will soon host the first regular commercial spaceflight service, which will enable thousands of people to see Earth from space with their own eyes.

-George Whitesides, CEO
Virgin Galactic and The Spaceship Company

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