



technology opportunity

Self-Contained Device Isolates Biological Samples for Molecular Analysis

Pipette-free technology enables analysis outside of laboratory settings



Innovators at NASA's Johnson Space Center (JSC) have developed a self-contained device for isolating deoxyribonucleic acid (DNA), ribonucleic acid (RNA), proteins, and cells without using pipettes or centrifuges. Composed of reagents, functionalized membranes, and four-way valves and pumps, this novel fluidic system employs highly accurate real-time polymerase chain reaction (PCR) technology to isolate genetic material from organisms and microorganisms for molecular analysis. The device is self-enclosed and leak-proof, so users are protected from chemically hazardous reagents. Developed to enable molecular diagnostics aboard the International Space Station (ISS), this easy-to-use analysis tool can be fully automated and programmed, extending laboratory isolation protocols to numerous applications in health care, forensics, and field biology.

Benefits

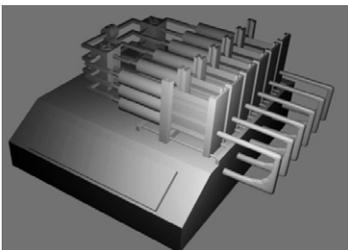
- **Compact and portable:** Contains DNA and RNA isolation kits in a book-sized (10 x 10 x 2 inches) unit
- **Self-contained:** Requires no auxiliary equipment (e.g., centrifuges, pipettes, syringes) to isolate desired targets
- **Safe:** Prevents hazardous chemicals required for PCR analysis from contaminating sensitive environments
- **Effective:** Offers sensitivities similar to those obtained using standard isolation methods

Applications

- Military field environments
- Remote clinical operations
- Forensic investigations
- Arctic operations
- Wilderness environments
- Agribusiness
- ISS and space vehicles



Automated system prototype
(NASA photo)



Prospective commercial product
(NASA rendering)

Technology Details

PCR is a common and indispensable sample analysis technique for a variety of research and clinical applications. In addition to detecting microorganisms and infectious diseases, the technology is useful for functional gene analysis, disease diagnosis, and DNA sequencing. However, its use (especially for sample isolation and preparation) outside of laboratory environments is limited due to conventional use of hazardous chemicals and auxiliary equipment. The JSC innovation will permit the extension of laboratory isolation protocols to many applications.

How It Works

The JSC-developed device is a component system that includes syringes and pistons, membranes of different capacities, reagents, four-way valves, and small pumps. The prefilled reagents are the same as those used in conventional PCR laboratory isolation analysis. The DNA and RNA isolation kits are novel and process small sample amounts using a self-enclosed and pipette-free technique. Multiple kits can be stacked to allow several samples to be processed simultaneously.

The system can be used in conjunction with existing analysis modules, such as commercially available DNA instruments. The process can be fully automated and programmed and can potentially be applied to other biological processes.

Why It Is Better

Real-time PCR is one of the most sensitive and accurate techniques available to diagnose human infectious diseases and conduct molecular biology analysis. Standard laboratory procedures for DNA/RNA isolation and pre-PCR preparation require at least six chemically hazardous reagents, multiple pipetting, centrifuge, and cleaning/changing tubes at multiple steps. Currently, PCR analysis cannot be used onboard the ISS or within space vehicles because of the hazardous chemicals required and because in microgravity it is impossible to pipette in order to isolate DNA/RNA.

JSC's technology provides hazard-free, microgravity-compatible hardware for DNA/RNA isolation. It also allows powerful PCR analysis to be used outside the lab in environments where pipetting is difficult and/or where hazardous chemicals must be confined to an enclosed container, such as military settings and remote clinical operations.

Patent

NASA has received patent protection (U.S. Patent No. 8,669,096) for this technology.

Licensing and Partnering Opportunities

This technology is part of NASA's Technology Transfer Program, which ensures that technologies developed for missions in exploration and discovery are broadly available to the public, maximizing the benefits to the Nation. NASA invites companies to consider licensing the Self-Enclosed and Pipette-Free DNA/RNA Isolation Device (MSC-24811-1) for commercial applications.

For More Information

If you would like more information or want to pursue transfer of this technology, please contact:

Technology Transfer and Commercialization Office

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