Form PTO-1595 (Rev. 07/05)
OMB No. 0651-0027 (exp. 6/30/2008)

U.S. DEPARTMENT OF COMMERCE
United States Patent and Trademark Office

RECORDATION FORM COVER SHEET
PATENTS ONLY

To the Director of the U.S. Patent and Trademark Office: Please record the attached documents or the new address(es) below.

1. Name of conveying party(ies)

MICHIGAN TECHNOLOGICAL UNIVERSITY
F49620-03-1-0027

Additional name(s) of conveying party(ies) attached? ☐ Yes ☑ No

2. Name and address of receiving party(ies)

Name: United States Air Force
Internal Address: AFOSR/JA
Street Address: 875 N. Randolph St
Suite 325, Rm 3112
City: Arlington
State: VA
Country: USA Zip: 22203

Additional name(s) & address(es) attached? ☐ Yes ☑ No

3. Nature of conveyance/Execution Date(s):

Execution Date(s) 25 JAN 06

☐ Assignment ☐ Merger
☐ Security Agreement ☐ Change of Name
☐ Joint Research Agreement
☐ Government Interest Assignment
☑ Executive Order 9424, Confirmatory License
☐ Other

4. Application or patent number(s):

☐ This document is being filed together with a new application.

A. Patent Application No.(s)
10/693,127

B. Patent No.(s)

Additional numbers attached? ☐ Yes ☑ No

5. Name and address to whom correspondence concerning document should be mailed:

Name: United States Air Force
Internal Address: AFOSR/JA
Street Address: 875 N. Randolph St
Suite 325, Rm 3112
City: Arlington
State: VA Zip: 22203
Phone Number: (703) 696-9500
Fax Number: (703) 696-7360
Email Address: raymond.marlow@afosr.af.mil

6. Total number of applications and patents involved: 1

7. Total fee (37 CFR 1.21(h) & 3.41) $ 0

☐ Authorized to be charged by credit card
☐ Authorized to be charged to deposit account
☐ Enclosed
☑ None required (government interest not affecting title)

8. Payment Information

a. Credit Card Last 4 Numbers _____
Expiration Date _____

b. Deposit Account Number _____

Authorized User Name _____

9. Signature:

_____ 14 Aug 06
Signature Date

MICHAEL K. GREENE, Maj, USAF, Staff Judge Advocate
Name of Person Signing

Total number of pages including cover sheet, attachments, and documents: 3

Documents to be recorded (including cover sheet) should be faxed to (571) 273-0140, or mailed to:
Mail Stop Assignment Recordation Services, Director of the USPTO, P.O.Box 1450, Alexandria, V.A. 22313-1450

MichiganTech
Michigan Technological University

Corporate Services

Advanced Technology Development Complex
1400 Townsend Drive
Houghton, Michigan 49931-1295
906-487-2228 • Fax 906-487-1979

January 19, 2006

AFOR/JA
4015 Wilson Blvd, Room 713
Arlington, VA 22203-1954

Invention Title: Vaporizing liquid metal anode for Hall-effect space propulsion systems

Inventor (s): Lyon Brad King

Patent or Application Serial No.: 10/693,127

U.S. Filing/Issue Date: 1/24/03

Grant/Contract Identification Number (s): F49620-03-10027

Foreign Applications filed/intended (countries):

The invention identified above is a Subject Invention under 35 U.S.C. 200, et seq., and the Standard Patent Rights clause at 37 CFR 401.14, FAR 52.227-11 or FAR 52.227-12 (if applicable) which are included among the terms of the above identified grant or contract award from the United States Government. This document is confirmatory of:

1. The nonexclusive, nontransferable, irrevocable, paid-up license to practice or have practiced for or on behalf of the United States the invention described in any patent application and in any and all divisions, continuations, and continuations-in-part, and in any and all patents and re-issues granted thereon throughout the world and;
2. All other rights acquired by the Government by reason of the above identified grant/contract award and the laws and regulations which are applicable to the award.

The Government is hereby granted an irrevocable power to inspect and make copies of the above-identified patent application.

Signed this 25th day of January, 2006

By _____

David D. Reed

Title: Vice President for Research

For Michigan Technological University

At 1400 Townsend Drive, Houghton, MI 49931

Mayer, R.X., "A Space-Charged-Sheath Electric Thruster," AIAA Journal 5(11), Nov. 1967, pp. 2057-2059; presented as Paper 66-627 at the AIAA Third Annual Meeting, Boston, Mass., Nov. 29 - Dec. 2, 1966. cited by oth- er.

Primary Examiner: Kim; Ted
Attorney, Agent or Firm: Michael Best & Friedrich

Government Interests

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

This invention was made with United States Government support under federal Grant No. F49620-03-1-0027 awarded by the United States Air Force, Air Force Research Labs. The United States Government has certain rights in this invention.

Claims

I claim:

1. A thruster for use with an external power supply, the thruster comprising: a propellant that exists in a non-gaseous state at standard temperature and pressure, the propellant having a melting point T.sub.m, and a boiling point T.sub.b; a plasma comprising ionized propellant vapors; a reservoir adapted to house the propellant in a non-gaseous state, the reservoir heated by the plasma; and at least one electrode positioned to intercept a fraction of the plasma to control heat input to the reservoir to maintain the temperature of the propellant between T.sub.m and T.sub.b.

2. The thruster set forth in claim 1, wherein the propellant comprises a metal.

3. The thruster set forth in claim 1, wherein the propellant comprises at least one of bismuth, mercury, cesium, cadmium, iodine, tin, indium, lithium and germanium.

4. The thruster set forth in claim 1, wherein the propellant exists in a solid state at standard temperature and pressure.

5. The thruster set forth in claim 1, wherein the amount of power from the external power supply deposited into the reservoir is approximately 20% of the total power supplied to the thruster.

6. The thruster set forth in claim 1, wherein the amount of power from the external power supply deposited into the reservoir ranges from approximately 15% to approximately 25% of the total power supplied to the thruster.

7. The thruster set forth in claim 1, wherein the reservoir comprises an anode in an electric circuit, and further comprising: a body having an axial direction and a radial direction; at least one passage in the reservoir to allow propellant vapors to escape the reservoir; a cathode positioned to emit electrons downstream of the body to create a substantially axial electric field with respect to the body, the electrons adapted to ionize the propellant vapors that have escaped the reservoir; and magnetic poles arranged to create a radial magnetic field that interacts with the axial electric field to produce a current