

ANNEX NO. 1
BETWEEN
THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LANGLEY RESEARCH CENTER
AND
THE ARIZONA BOARD OF REGENTS FOR AND ON BEHALF OF
ARIZONA STATE UNIVERSITY
UNDER
SPACE ACT UMBRELLA AGREEMENT NO. SAA1-34287
FOR
INVESTIGATION OF BIO-INSPIRED MATERIAL SURFACES FOR DUST
MITIGATION IN SPACE APPLICATIONS

ARTICLE 1. PURPOSE

In collaboration with the Arizona Board of Regents for and on behalf of Arizona State University (ASU) and NASA Langley Research Center (LaRC), this work will evaluate the effects of changing the surface textures of additively manufactured structures for lunar dust adhesion and erosion applications. The work will also aim to identify 3D printable resins tolerant of temperature extremes for space exploration vehicles and having lunar dust adhesion and erosion mitigation properties.

The proposed activity seeks to evaluate 3D printed materials, uniquely surface textured by ASU, using specialized materials characterization techniques at NASA LaRC. The specific tasks of this proposed activity include ASU producing, characterizing and providing material test articles to NASA LaRC, NASA LaRC collaborating with ASU to identify further surface textures for evaluation, NASA LaRC assessing and testing properties of the 3D printed samples relevant to applications in extreme space environments, such as on the lunar surface, and joint characterization of material surface and structural properties of the test articles by ASU and NASA LaRC, followed by presentation and publication of results.

The legal authority for this Annex, consistent with the Umbrella Agreement, is in accordance with the National Aeronautics and Space Act (51 U.S.C. § 20113(e)).

ARTICLE 2. RESPONSIBILITIES

A. NASA LaRC will use reasonable efforts to:

1. Collaborate with ASU regarding materials, bio-inspired surface textures, and the approach for ASU to create material test samples.
2. Review characterization test results completed by ASU.
3. Receive no more than fifteen (15) material test samples from ASU.
4. Characterize and evaluate material test samples using unique NASA LaRC test methods for relevance in space environment applications.

5. Review characterization and evaluation results on initial samples with ASU. Collaborate with ASU to develop additional sample compositions and configurations.
6. Review characterization test results completed by ASU.
7. Receive no more than five (5) material test samples from ASU.
8. Characterize and evaluate material test samples using unique NASA LaRC test methods for relevance in space environment applications.
9. Provide support and input in preparing peer-reviewed journal article and conference presentations related to this work.

B. Partner will use reasonable efforts to:

1. Collaborate with NASA LaRC to produce different materials and unique surface textured material test samples for evaluation.
2. Process and characterize starting materials.
3. Send no more than fifteen (15) material test samples to NASA LaRC.
4. Review characterization and evaluation results on initial samples with ASU. Collaborate with NASA to develop additional sample compositions and configurations.
5. Process and characterize refined materials.
6. Send no more than five (5) material test samples to NASA LaRC.
7. Review characterization and evaluation results on initial samples with ASU. Collaborate with NASA to develop additional sample compositions and configurations.
8. Provide support and input in preparing peer-reviewed journal article and conference presentations related to this work.

ARTICLE 3. SCHEDULE AND MILESTONES

The planned major milestones for the activities for this Annex defined in the "Responsibilities" Article are as follows:

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| 1. ASU and NASA LaRC to collaborate to produce and share no more than twenty (20) material test samples to NASA LaRC. | Within ten (10) months of execution of this Annex |
| 2. ASU to generate initial test samples, perform testing and characterization deemed necessary by both parties and share results. | Within three (3) months after Milestone 1 |
| NASA LaRC to review characterization test results generated by ASU. | Throughout the period of performance |
| 3. ASU to send no more than fifteen (15) material test samples to NASA LaRC for further characterization and testing as deemed necessary by both parties. | Within two (2) months after Milestone 2 |
| NASA LaRC to collaborate with ASU regarding materials, bio-inspired surface textures, and the approach for ASU to | Throughout the period of performance |

create material test samples

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|---|---|
| 4. NASA LaRC to perform characterization deemed necessary by both parties and shares results. | Within three (3) months after Milestone 3 |
| ASU to review characterization test results generated by NASA LaRC. | Throughout the period of performance |
| 5. ASU to generate refined test samples, perform testing and characterization deemed necessary by both parties and share results. | Within three (3) months after Milestone 4 |
| 6. ASU to send no more than five (5) material test samples to NASA LaRC for further characterization and testing as deemed necessary by both parties. | Within two (2) months after Milestone 5 |
| 7. NASA LaRC to perform characterization deemed necessary by both parties and shares results. | Within three (3) months after Milestone 6 |
| 8. NASA LaRC to work with ASU to potentially generate presentations and peer reviewed journal publications from results. | Within 10 months after Milestone 7 |

ARTICLE 4. FINANCIAL OBLIGATIONS

There will be no transfer of funds between the Parties under this Agreement and each Party will fund its own participation. All activities under or pursuant to this Agreement are subject to the availability of funds, and no provision of this Agreement shall be interpreted to require obligation or payment of funds in violation of the Anti-Deficiency Act, (31 U.S.C. § 1341).

ARTICLE 5. INTELLECTUAL PROPERTY RIGHTS - DATA RIGHTS

A. Data produced under this Annex which is subject to paragraph C. of the Intellectual Property Rights - Data Rights Article of the Umbrella Agreement will be protected for the period of two (2) years.

B. Under paragraph H. of the Intellectual Property Rights - Data Rights Article of the Umbrella Agreement, Disclosing Party provides the following Data to Receiving Party. The lists below may not be comprehensive, are subject to change, and do not supersede any restrictive notice on the Data provided.

1. Background Data: *The Disclosing Party's Background Data, if any, will be identified in a separate technical document.*
2. Third Party Proprietary Data: *The Disclosing Party's Third Party Proprietary Data, if any, will be identified in a separate technical document.*
3. Controlled Government Data: *The Disclosing Party's Controlled Government Data, if any, will be identified in a separate technical document.*

4. The following software and related Data will be provided to Partner under a separate Software Usage Agreement: *None*.

ARTICLE 6. TERM OF ANNEX

This Annex becomes effective upon the date of the last signature below ("Effective Date") and shall remain in effect until the completion of all obligations of both Parties hereto, or three (3) years from the Effective Date, whichever comes first, unless such term exceeds the duration of the Umbrella Agreement. The term of this Annex shall not exceed the term of the Umbrella Agreement. The Annex automatically expires upon the expiration of the Umbrella Agreement.

ARTICLE 7. RIGHT TO TERMINATE

Either Party may unilaterally terminate this Annex by providing thirty (30) calendar days written notice to the other Party.

ARTICLE 8. POINTS OF CONTACT

The following personnel are designated as the Points of Contact between the Parties in the performance of this Annex.

Technical Points of Contact

NASA Langley Research Center
Christopher Wohl
Senior Research Surface Scientist
Mail Stop: 226
Langley Research Center
Hampton, VA 23681
Phone: 757-864-8074
Fax: 757-864-8312
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Arizona State University
Dhruv Bhate
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6075 Innovation Way West
Mail Code 2180
Meza, AZ 85212-0000
Phone: 765-430-0186
Fax: 480-965-3610
dpbhate@asu.edu

ARTICLE 9. MODIFICATIONS

Any modification to this Annex shall be executed, in writing, and signed by an authorized representative of NASA and the Partner. Modification of an Annex does not modify the terms of the Umbrella Agreement.

[Remaining page intentionally left blank; signatures to follow on next page.]


ARTICLE 10. SIGNATORY AUTHORITY

The signatories to this Annex covenant and warrant that they have authority to execute this Annex. By signing below, the undersigned agrees to the above terms and conditions.

NATIONAL AERONAUTICS AND
SPACE ADMINISTRATION
LANGLEY RESEARCH CENTER

ARIZONA STATE UNIVERSITY

BY: _____
David A. Dress
Director, Space Technology and
Exploration Directorate

BY:  _____
Kristy Macdonald
Assistant Director, Research
Operations

DATE: _____

DATE: 4/2/2021 _____