Circularly Polarized Microwave Antenna Element With Very Low Off-Axis Cross-Polarization

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The goal of this work was to improve off-axis cross-polarization performance and ease of assembly of a circularly polarized microwave antenna element. To ease assembly, the initial design requirement of Hexweb support for the internal circuit part, as well as the radiating disks, was eliminated.

There is a need for different plating techniques to improve soldering. It was also desirable to change the design to eliminate soldering as well as the need to use the Hexweb support. Thus, a technique was developed to build the feed without using solder, solving the lathing and soldering issue. Internal parts were strengthened by adding curvature to eliminate Hexweb support, and in the process, the new geometries of the internal parts opened the way for improving the off-axis cross-polarization performance as well.

The radiating disks' curvatures were increased for increased strength, but it was found that this also improved cross-polarization. Optimization of the curvatures leads to very low off-axis cross-polarization. The feed circuit was curved into a cylinder for improved strength, eliminating Hexweb support. An aperture coupling feed mechanism eliminated the need for feed pins to the disks, which would have required soldering. The aperture coupling technique also improves cross-polarization performance by effectively exciting the radiating disks very close to the antenna's central axis of symmetry. Because of the shape of the parts, it allowed for an all-aluminum design bolted together and assembled with no solder needed.

The advantage of a solderless design is that the reliability is higher, with no single-point failure (solder), and no need for special plating techniques in order to solder the unit together. The shapes (curved or round) make for a more robust build without extra support materials, as well as improved off-axis cross-polarization.

This work was done by David Green and Cornelis Du Toit of Goddard Space Flight Center. Further information is contained in a TSP (see page 1). GSC-15727-1

Ultra-Low Heat-Leak, High-Temperature Superconducting Current Leads for Space Applications

Goddard Space Flight Center, Greenbelt, Maryland

NASA Goddard Space Flight Center has a need for current leads used in an adiabatic demagnetization refrigerator (ADR) for space applications. These leads must comply with stringent requirements such as a heat leak of approximately 100 μW or less while conducting up to 10 A of electric current, from more than 90 K down to 10 K. Additionally, a length constraint of < 300 mm length and < 50 mm diameter is to be maintained.

The need for these current leads was addressed by developing a superconducting hybrid lead. This hybrid lead comprises two different high-temperature superconducting (HTS) conductors bonded together at a thermally and electrically determined optimum point along the length of the current lead. By taking advantage of material properties of each conductor type, employing advanced fabrication techniques, and taking advantage of novel insulation materials, the company was able to develop and fabricate the lightweight, low heat-leak leads currently to NASA's specs.

This work was done by Christopher M. Rey of the Tai-Yang Research Company for Goddard Space Flight Center. Further information is contained in a TSP (see page 1). GSC-16045-1

Flash Cracking Reactor for Waste Plastic Processing

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Conversion of waste plastic to energy is a growing problem that is especially acute in space exploration applications. Moreover, utilization of heavy hydrocarbon resources (wastes, waxes, etc.) as fuels and chemicals will be a growing need in the future. Existing technologies require a trade-off between product selectivity and feedstock conversion. The objective of this work was to maintain high plastic-to-fuel conversion without sacrificing the liquid yield. The developed technology accomplishes this goal with a combined understanding of thermodynamics, reaction rates, and mass transport to achieve high feed conversion without sacrificing product selectivity.

The innovation requires a reaction vessel, hydrocarbon feed, gas feed, and pressure and temperature control equipment. Depending on the feedstock and desired product distribution, catalyst can be added. The reactor is heated to the desired temperature, pressurized to the desired pressure, and subject to a sweep flow at the optimized superficial velocity. Software developed under this project can be used to determine optimal values for these parameters. Product is vaporized, transferred to a receiver, and cooled to a liquid — a form suitable for long-term storage as a fuel or chemical. An important NASA application is the use of solar energy to convert waste plastic into a form that can be utilized during periods of low solar energy flux.

Unlike previous work in this field, this innovation uses thermodynamic, mass transport, and reaction parameters to tune product distribution of pyrolysis cracking. Previous work in this field has used some of these variables, but never all in conjunction for process optimization.

This method is useful for municipal waste incinerator operators and gas-to-liquids companies.

This work was done by Michael T. Timko, Hsi-Wu Wong, and Lino A. Gonzalez of Aerodyne Research, Inc.; and Linda Broadbelt and Vinu Ravikrishan of Northwestern University for Glenn Research Center. Further information is contained in a TSP (see page 1).

Inquiries concerning rights for the commercial use of this invention should be addressed to NASA Glenn Research Center, Innovative Partnerships Office, Attn: Steven Fedor, Mail Stop 4–8, 21000 Brookpark Road, Cleveland, Ohio 44135. Refer to LEW-18843-1.