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Short Company presentation

(R & D guidelines, international activities, etc.)

Orbital Engenharia is a Brazilian aerospace and defense technology company dedicated to the development of advanced engineering solutions for space and strategic applications. The company conducts intensive research and development focused on high-reliability systems for space environments, contributing to the advancement of Brazil's technological capabilities in the aerospace sector.
Its R&D activities are guided by the development of innovative technologies for satellites, launch systems, and scientific experimentation platforms, combining engineering excellence with strong collaboration with research institutions, industry partners, and government organizations. Through participation in international programs and scientific initiatives, Orbital Engenharia contributes to global efforts in space technology development and microgravity research, positioning itself as a relevant partner in advanced aerospace engineering projects.

DESCRIPTION OF ITS TECHNOLOGY AND CAPABILITIES IN R & D

(Products, technologies, applications, services, etc.)

Orbital Engenharia develops technologies and products for space and defense applications, with strong capabilities in the design, development, integration, and testing of complex aerospace systems. Its R&D portfolio includes satellite subsystems, space power generation systems, propulsion and fluid management systems for launch vehicles, and platforms for microgravity experimentation.

The company also develops specialized equipment and infrastructure for the testing and qualification of aerospace components and scientific payloads. These technologies support a wide range of applications including satellite missions, scientific experiments in microgravity environments, and advanced aerospace engineering projects.

In addition to product development, Orbital Engenharia provides high-level engineering services such as system architecture design, prototyping, integration, testing, and technical support for complex R&D programs. Its capabilities enable the company to contribute to strategic projects in the space and defense sectors while generating technological impact and innovation in the aerospace industry.

PROPOSED COLLABORATIVE PROJECT IN R & D

(As much detail as possible, both in what it offers and what you want in a potential partner)

Proposed Collaborative Projects (R&D)

Flexible Triple Junction Solar Cell
Development of Industrial-Scale Manufacturing Processes for Triple-Junction Solar Cells for Space Applications

1. Executive Summary
This project proposes the development and validation of industrial-scale manufacturing processes for triple-junction solar cells (TJSCs) for space applications, based on epitaxial growth of III–V semiconductor materials on germanium (Ge) substrates. Triple-junction solar cells currently represent the highest-efficiency photovoltaic technology used in space, with demonstrated efficiencies between 27% and 32%, and are a critical enabling technology for modern satellite missions in both low Earth orbit (LEO) and geostationary orbit (GEO).
The project will establish complete technological mastery over the design, fabrication, and processing of space-qualified TJSCs, starting from commercially available Ge substrates and progressing through epitaxial growth, device processing, and experimental qualification. The outcome will be a validated set of manufacturing processes suitable for integration into satellite solar panel production lines, strengthening technological autonomy and advancing capabilities in space solar energy systems.

2. Background and Rationale
Multi-junction solar cells based on III–V semiconductor materials are currently the most efficient photovoltaic devices available. Among them, triple-junction solar cells grown on Ge substrates are widely adopted in space missions due to their:

High conversion efficiency;
Excellent radiation resistance;
Proven long-term reliability in harsh orbital environments.

These devices typically consist of a stack of semiconductor junctions (e.g., InGaP/GaAs/Ge), each optimized to absorb a different portion of the solar spectrum. The multilayer structure is grown by epitaxial techniques and requires highly controlled processing steps to meet the stringent performance, yield, and reliability requirements of space applications.

Despite their widespread use, industrial-scale manufacturing of TJSCs demands advanced and tightly integrated process control, from epitaxial growth to lithography, metallization, and surface passivation. Developing local or in-house expertise in these processes is strategically important for satellite manufacturing, space infrastructure, and national space programs.

3. Objectives

General Objective

To develop, master, and validate industrial-scale manufacturing processes for triple-junction solar cells for space use, from epitaxial growth on Ge substrates to experimental verification of suitability for satellite solar panel integration.

Specific Objectives

a) To master the technology for manufacturing TJSCs by epitaxial deposition of III–V semiconductor materials on germanium substrates, including control of composition, doping, thickness, and crystalline quality of the epitaxial layers.

b) To develop space-qualified processing techniques, including:

Dry and wet etching processes.
Photolithography for fine-pattern definition;
Metallization of low-resistance ohmic electrical contacts;
Thickening of metallic grids to reduce series resistance;
Deposition of anti-reflective (AR) coatings optimized for the solar spectrum in space.

c) To integrate epitaxial growth and processing techniques on Ge substrates to fabricate complete triple-junction solar cell devices.

d) To experimentally verify the suitability of the developed TJSCs for satellite solar panel manufacturing, through electrical, optical, and environmental testing on representative specimens.

4. Scope of Work

The project encompasses the full manufacturing chain for space-use TJSCs, including:

Device design (junction structure, layer composition, doping profiles, thicknesses);
Definition of electrical contacts and anti-reflective coatings;
Epitaxial growth of multi-junction III–V structures on Ge substrates;
Microfabrication and device processing;
Experimental testing and qualification.

The work explicitly targets scalable manufacturing processes, ensuring compatibility with industrial production environments rather than laboratory-only demonstrations.

5. Technical Approach and Methodology

5.1 Design of Triple-Junction Solar Cells

The TJSC design phase will define:

Material composition of each junction (e.g., InGaP top cell, GaAs middle cell, Ge bottom cell);

Doping levels and junction depths;

Thickness optimization for current matching;

Design of front and rear electrical contacts;

Anti-reflective coating stack tailored to space solar spectra.

Simulation and modeling tools will be used to optimize device performance prior to fabrication.

5.2 Epitaxial Growth on Ge Substrates

The project will develop and optimize epitaxial deposition processes for III–V semiconductor layers on commercially available Ge substrates. Key activities include:

Substrate preparation and surface conditioning;

Control of lattice matching and defect density;

Precise control of growth parameters to ensure high crystalline quality;

Reproducibility and uniformity suitable for industrial scaling.

5.3 Device Processing Techniques

Processing techniques will be developed and qualified for space-use TJSCs, including:

Photolithography: High-resolution patterning for device definition and front grid structures.

Etching: Selective removal of semiconductor layers with controlled profiles.

Metallization:

Formation of low-resistance ohmic contacts;

Thickening of metallic tracks to minimize series resistance and power losses.

Anti-Reflective Coatings:

Deposition of single- or multi-layer AR films;

Optimization for maximum optical coupling and environmental stability in space.

All processes will be assessed for repeatability, yield, and compatibility with large-scale manufacturing.

5.4 Integration and Fabrication of TJSCs

The complete fabrication flow will be implemented to produce functional triple-junction solar cells. This phase integrates epitaxial growth with microfabrication processes, emphasizing:

Process integration and sequence optimization;

Yield analysis and defect mitigation;

Electrical and optical performance consistency.

5.5 Experimental Verification and Testing

To verify suitability for satellite solar panel manufacturing, the fabricated TJSCs will undergo:

Electrical characterization (I–V curves, efficiency, series resistance);

Spectral response and quantum efficiency measurements;

Environmental and reliability-related tests relevant to space conditions;

Mechanical and handling assessments for panel assembly compatibility.

The results will demonstrate compliance with space application requirements.

6. Expected Results and Deliverables

A complete and validated industrial-scale manufacturing process flow for space-use TJSCs;

Fabricated and tested triple-junction solar cell specimens;

Demonstration of efficiencies consistent with state-of-the-art space solar cells;

Documentation of process parameters, design rules, and quality controls;

Technical reports supporting technology transfer to satellite solar panel manufacturing.

7. Impact and Strategic Relevance

This project will:

Strengthen technological autonomy in space solar energy systems;

Enable domestic or in-house production of high-efficiency TJSCs;

Support advanced satellite missions in LEO and GEO;

Reduce reliance on external suppliers for critical space hardware;

Create a technological foundation for future multi-junction and next-generation space solar cells.

General comments:

- By sending this information document authorizing its dissemination.
- A company profile must be attached or a link to the company's website must be provided: https://orbitalengenharia.com.br/