



## Manufacturing & Prototyping

### Buckyball Nucleation of HiPco Tubes

*Lyndon B. Johnson Space Center, Houston, Texas*

The purpose of this innovation is to enhance nucleation of single-wall nanotubes (SWNTs) in the HiPco process, selectively producing 10,10 tubes, something which until now has not been thought possible.

This is accomplished by injecting  $C_{60}$ , or a derivative of  $C_{60}$ , solubilized in supercritical  $CO_2$  together with a transition metal carbonyl co-catalyst into the HiPco reactor. This is a variant on the "supercritical" disclosure.  $C_{60}$  has never

been used to nucleate carbon nanotubes in the gas phase.

$C_{60}$  itself may not have adequate solubility in supercritical  $CO_2$ . However, fluorinated  $C_{60}$ , e.g.,  $C_{60}F_{36}$ , is easy to make cheaply and should have much enhanced solubility.

*This work was done by Richard E. Smalley of Rice University for Johnson Space Center. For further information, contact the JSC Innovation Partnerships Office at (281) 483-3809.*

*In accordance with Public Law 96-517, the contractor has elected to retain title to this invention. Inquiries concerning rights for its commercial use should be addressed to:*

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*Refer to MSC-24134-1, volume and number of this NASA Tech Briefs issue, and the page number.*

### FACT, Mega-ROSA, SOLAROSA

**These technologies have applications in fixed and mobile large-area photovoltaic renewable energy systems.**

*John H. Glenn Research Center, Cleveland, Ohio*

The Flexible Array Concentrator Technology (FACT) is a lightweight, high-performance reflective concentrator blanket assembly that can be used on flexible solar array blankets. The FACT concentrator replaces every other row of solar cells on a solar array blanket, significantly reducing the cost of the array. The modular design is highly scalable for the array system designer, and exhibits compact stowage, good off-pointing acceptance, and mass/cost savings. The assembly's relatively low concentration ratio, accompanied by a large radiative area, provides for a low cell operating temperature, and eliminates many of the thermal problems inherent in high-concentration-ratio designs. Unlike other reflector technologies, the FACT concentrator modules function on both z-fold and rolled flexible solar array blankets, as well as rigid array systems.

Mega-ROSA (Mega Roll-Out Solar Array) is a new, highly modularized and extremely scalable version of ROSA that provides immense power level range capability from 100 kW to several MW in size. Mega-ROSA will enable extremely high-power spacecraft and SEP-powered missions, including space-tug and large-scale planetary science and lunar/asteroid exploration missions. Mega-ROSA's

inherent broad power scalability is achieved while retaining ROSA's solar array performance metrics and mission-enabling features for lightweight, compact stowage volume and affordability.

This innovation will enable future ultra-high-power missions through low-cost (25 to 50% cost savings, depending on PV and blanket technology), lightweight, high specific power (>200 to 400 W/kg BOL (beginning-of-life) at the wing level depending on PV and blanket technology), compact stowage volume (>50 kW/m<sup>3</sup> for very large arrays), high reliability, platform simplicity (low failure modes), high deployed strength/stiffness when scaled to huge sizes, and high-voltage operation capability. Mega-ROSA is adaptable to all photovoltaic and concentrator flexible blanket technologies, and can readily accommodate standard multi-junction and emerging ultra-lightweight IMM (inverted metamorphic) photovoltaic flexible blanket assemblies, as well as ENTECH's Stretched Lens Array (SLA) and DSSs (Deployable Space Systems') FACT, which allows for cost reduction at the array level.

The SOLAROSA technology embodiment is the fusion of a mass-optimized ROSA structural system integrated to a new version of ENTECH's lightweight

SLA (Stretched Lens Array) linear refractive concentrator blanket assembly. The SOLAROSA flexible blanket concentrator solar array can be rolled or z-folded, and enables NASA's emerging Space Science and Exploration high-voltage solar electric propulsion (SEP) missions.

This innovation is a potentially revolutionary solar array that provides game-changing performance in terms of high specific power (>400 to 500 W/kg BOL at wing level), affordability (>50% projected cost savings at the array level), light weight, high deployed stiffness, high deployed strength, compact stowage volume (>60 to 80 kW/m<sup>3</sup> BOL), reliability, high radiation tolerance, high-voltage operation capability, scalability, and LILT and HIHT operation capability (LILT—low intensity low temperature; HIHT—high intensity high temperature).

*This work was done by Brian Spence, Steve White, Kevin Schmid, and Mark Douglas of Deployable Space Systems, Inc. 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-18833/4/5-1.*