ADVANCES IN COMPOSITES FOR TERAHERTZ RADIO ASTRONOMY

S.J. Connell, D.A. Giles
Composite Optics, Inc. (COI)
9617 Distribution Ave.
San Diego, CA 92121
(858) 621-5700
sconnell@coi-world.com

In recent years, Composite Optics, Inc. (COI) has made significant advances in the use of carbon fiber reinforced polymer (CFRP) composite materials for astronomical instrument applications. The inherent low density, high stiffness, and excellent thermal stability of CFRP makes this class of material a natural candidate for many astronomy applications, particularly for space-borne instruments. In recent years, research and development at COI has focused on how to reap these inherent benefits in astronomical applications where other demanding requirements also exist. Basic research has focused on material and process improvement, resulting in an 4 – 5X improvement in the accuracy, homogeneity, isotropy, and thermal stability of the basic material. This has been accompanied by the design, fabrication, and test of large prototype reflectors that cover a broad wavelength spectrum of astronomical interests. Three examples are: a passively adjusted 3-meter aperture prototype reflecting surface for the Large Millimeter Telescope (LMT), the 2-meter aperture prototype mirror for the Far InfraRed and Submillimeter Space Telescope (FIRST), and a 1.6-m prototype for the Next Generation Space Telescope (NGST).

These recent accomplishments have two important implications for the design and fabrication of primary reflectors that can meet the requirements of terahertz astronomy. First, COI has demonstrated a variety of techniques for fabricating large reflecting surfaces from composites to a few microns of accuracy. In addition to high as-manufactured accuracy, an all-composite reflecting surface will have a coefficient of thermal expansion (CTE) of less than 0.1 ppm/°C. This may be the only material that can meet the thermal stability requirements for a ground-based terahertz instrument approach. Secondly, material advances can be applied to primary and secondary support structure, where unparalleled thermal stability may also be enabling for terahertz instruments. New design and manufacturing approaches also have the potential to dramatically minimize the need for high-expansion metallic fittings in these areas.