National Aeronautics and Space Administration

TECHNOLOGY SOLUTION

Materials and Coatings

Computer-implemented energy depletion radiation shielding

Stacked Energy Depletion Radiation Shielding (SEDRS) and Layered Energy Depletion Radiation Shielding (LEDRS)

Radiation shielding for space as well as some terrestrial applications is challenging due to the wide variety and energy ranges of radiation particles. Thin layers of material or shielding, or both, placed between the radiation environment and a target, sensitive electronics or biology, has some effect on mitigating radiation dose or damage caused by radiation in a material. Another issue with common radiation shielding designs is that a single shielding material will respond differently to different types or energies of radiation or might produce secondary radiation that can be just as damaging as the primary radiation. NASA Ames has developed a novel technology that provides a new process for designing and accurately "tuning" radiation shields to possess the specific characteristics required for each application before testing, reducing the need for iterative radiation beam testing throughout the development process.

BENEFITS

- Efficient design of radiation shields tailored for specific radiation environments; analyzing the potential properties of different shielding combinations aids in reductions in the cost and time to design the shielding
- For electronics, better shielding allows for more advanced, less radiation-hardened circuits to be used without failure
- SEDRS and LEDRS method can be applied iteratively in conjunction with practical manufacturing constraints to develop the best possible shielding material for a given application
- Stacking shielding layers so that each layer's response peak is to the right (at a higher energy level) of the target material's response peak ensures that the most detrimental radiation is blocked by the shielding
- Adjusting each shielding layer's response to match the shifted radiation environment resulting from the initial radiation environment passing through previous shielding layers
- Developing normalized shielding layer ratios for a given composition of shielding materials that provide the thinnest possible shielding layer with maximum amount of energy absorption
- SEDRS and LEDRS can improve any technology that relies on the controlled manipulation of a radiation field by interaction with a material element

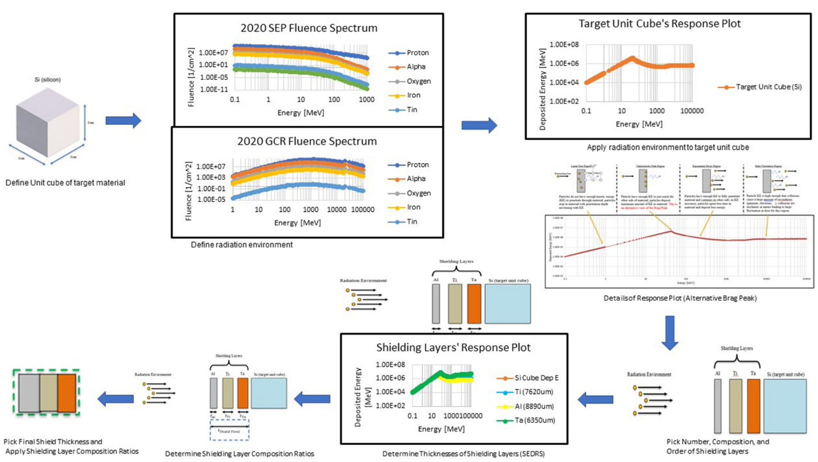
THE TECHNOLOGY

The difference between Layered Energy Depletion Radiation Shielding (LEDRS) and Stacked Energy Depletion Radiation Shielding (SEDRS) is how the piece of matter, or shield, is analyzed as radiation passes through the matter.

SEDRS involves using a defined and ordered stack of layers of shielding with different material properties such that the thickness and chemical properties of each material maximizes the absorption of energy from the radiation particles that are most damaging to the target. The SEDRS shielding method aims to provide the maximum level of energy absorption while still keeping shielding mass and volume low.

The process of LEDRS involves using layers of shielding material such that the thickness of each material is designed to absorb the maximum amount of energy from the radiation particles that are most damaging to the target after subsequent layers of shielding. The more energy is absorbed by the shielding material, the less energy will be deposited in the target minimizing the required mass to achieve a resulting lower dose for a given geometrical feature. The LEDRS shielding method aims to provide the maximum level of energy absorption. The process for designing LEDRS views potential radiation shields as a cascade of effects from each shielding layer to the next and is helpful for investigating the particular effects of each layer.

SEDRS and LEDRS can improve any technology that relies on the controlled manipulation of a radiation field by interaction with a material element.



SEDRS Method

APPLICATIONS

The technology has several potential applications:

- Space Industry – for improving radiation shielding for manned missions to the Moon or Mars, or providing enhanced radiation capabilities to satellites in LEO
- Medical industry – for improving medical radiation therapy by enabling the optimization of radiation-lensing systems to emit only the desired radiation, as well the optimization of lens materials for reduced cost. Such lensing systems may be employed for MRI, CT, and radiation therapy devices, among others
- Ion propulsion applications – for providing tailored radiation “lensing” to create the radiation streams with the desired characteristics
- Energy industry – for providing shielding as in the space industry, or for assisting in the development of new energy methods by enabling specific, controlled reactions
- The integrated circuit industry – for developing radiation-tolerant packaging
- Department of Defense – for protecting of soldiers from radiation hazards
- Department of Energy – for using in nuclear defense labs
- Sensor instruments – for using with controlled beams of radiation in X-rays, CAT Scans, and a variety of other sensors to induce reactions from a target that can be measured and analyzed
- Commercial and military aircraft – for providing improved radiation shielding

PUBLICATIONS

Patent Pending

technology.nasa.gov

More Information

National Aeronautics and Space Administration

Agency Licensing Concierge

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NP-2015-05-1885-HQ

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ARC-18488-1, TOP2-304