High Volume Method of Making Low Cost, Lightweight Solar Materials

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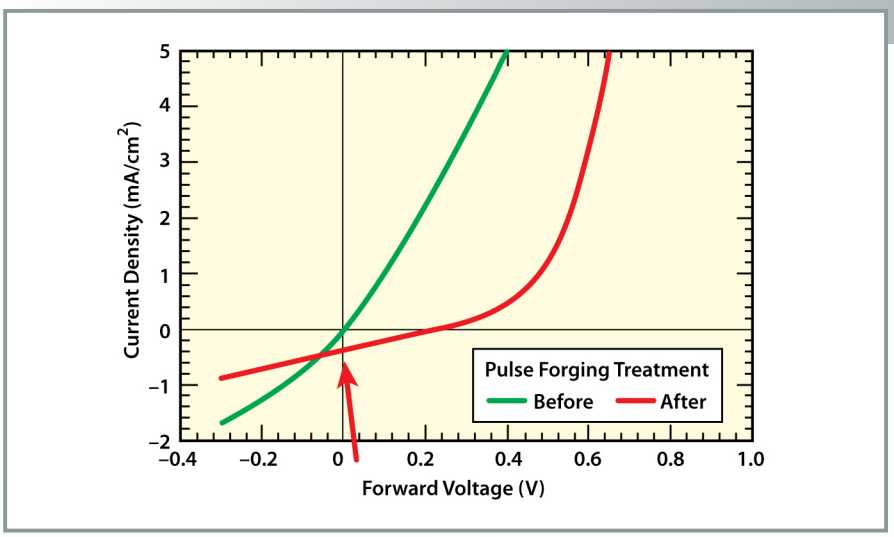

Technology Summary

A critical challenge for solar energy is the high cost (>$1/W) of quality solar materials. Researchers at ORNL have invented an approach for producing large volumes of solar cell material at a fraction of the cost of today's solar cells. The concept combines ORNL's unique pulse thermal processing (PTP) capabilities with standard high-volume manufacturing techniques to improve the performance of extremely low cost solar cell materials. The idea entails roll-to-roll manufacturing techniques on low temperature substrate materials, to produce flexible thin film solar cell materials. The potential exists to produce more than 1 GW of solar capacity per year at manufacturing costs below $0.50/W.

Low cost manufacturing approaches such as roll-to-roll techniques that utilize low cost polymer substrates are typically not feasible for most photovoltaic materials, which require very high temperature processing. The researchers use intense pulses of radiant energy to improve the material quality and advanced device concepts to increase the specific power. A low quality solar cell material that has been deposited over large areas in a high volume, low cost manner can be pulsed with radiant energy to enhance its performance.

ORNL recently demonstrated the proof of principle for cadmium telluride (CdTe), a crystalline compound used as a solar cell material, using a sputtering approach on lightweight solar materials. The CdTe thin film was sputtered onto a polymer substrate at room temperature. X-ray diffraction (XRD) of the deposited sputtered solar materials showed that the initial CdTe deposits were crystalline, not amorphous thin films. PTP was used to tailor the depositions for crystal axis, morphology, and other properties. The XRD spectra after PTP showed that the plasma treatment increased the crystallinity, as expected.

Advantages

- Has the potential to produce large volumes of solar cell material at a fraction of the manufacturing costs of today's solar cells
- PTP is combined with standard large-area, high-volume manufacturing techniques to improve the performance of extremely low cost solar cell materials
- Can be paired with conventional roll-to-roll manufacturing techniques on low temperature substrate materials
- Potential to produce more than 1GW of solar capacity per year at manufacturing costs below $0.50/W

Potential Applications

- Attractive materials for integrating solar energy generation into existing or new building structures, for fabrics (such as clothes, backpacks, and temporary shelters), and for consumer electronic products (cell phones, laptops, and cameras).
- For both large and small scale automotive and aeronautical applications. The electrical potential could be a driving force for large area chemical reactions to generate fuels or clean water.
- Advantageous for military applications: Thin film photovoltaics can be combined with thin film energy storage systems (other side of film) to provide energy generation and energy storage when there is no sunlight.

Patent

Application in preparation

Lead Inventor

Craig A. Blue
Energy and Engineering Sciences Directorate
Oak Ridge National Laboratory

Licensing Contact

Alexander G. DeTrana
Technology Commercialization, Energy and Engineering Sciences
UT-Battelle, LLC
Oak Ridge National Laboratory
Office Phone: 865.576.9682
E-mail: detranaag@ornl.gov