Quick, Efficient Film Deposition for Nanomaterials

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Technology Summary

Researchers at ORNL developed a process for manufacturing a thin film from a layer of particles, as well as complex three dimensional devices. The nanomaterials are deposited, and then rapidly fused into a functional, multi-material thin-film. The process saves time and energy compared to conventional methods.

A significant challenge in conventional thin film production is the need to use multiple deposition and annealing steps for introducing and reacting each of the elements which comprise a single layer of film. This makes current deposition methods, such as those used for photovoltaic compositions, especially costly. In addition, these methods often use highly toxic chemicals in a selenization step. It is also difficult with current methods to assure batch-to-batch consistency.

The ORNL instant method uses a pulse of thermal energy on a layer of particles to merge at least some of the particles by melting. A single precursor deposition step can be followed by a single film-forming step. By optimizing the particle composition, thin films with precise features can be made in a reproducible manner at a commercial scale. Both continuous thin films (with no pores) and thin films with various degrees of porosity can be produced with this method.

Advantages

- Multi-material nanoparticles can be deposited over a large surface (e.g., CdS, CIGS, CdTe) to rapidly manufacture a thin film with consistent material stoichiometry
- Different types of nanomaterials (e.g., magnetic, electrical, thermal, structural) can be selectively deposited over a single layer and rapidly consolidated into a functional thin film for rapid manufacturing of functional three-dimensional devices
- Films can be deposited uniformly in a one-step deposition of nanoparticles with optimized drop distribution, making it possible to change the coating morphology

Applications

- Magnetic, optical, photonic and electronic devices
- Photovoltaic cells, laser diodes and solid state lighting
- Printed circuit board fluxing, medical nanocoatings, fuel cells, and thin-film solar cells

Patent

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