An Improved Method for Depositing Semiconductive Materials for Photovoltaic Solar Cells

Technology Summary
This invention provides a method and apparatus for depositing alloy films that are used in manufacturing photovoltaic solar cells, which convert sunlight into electricity. The technology enables easy scaling to produce the large wafers that are required for photovoltaic solar cells. It is also safer than other processes because it does not use toxic materials, such as hydrogen selenide, and provides uniform deposition over large working areas. The method can be used to deposit coatings with graded copper-indium compositions or alloy coatings. It also can be adapted for use in ion-assisted depositions.

Benefits
This invention offers the following advantages for large-scale production of semiconductor films used in manufacturing photovoltaic solar cells:

• Safe: This technology does not require the use of hydrogen selenide or other dangerous materials

• Usable at large scale/volume: This technology provides uniform deposition over large working areas and can be scaled up to produce a large volume and size of films.

• Controllable: This technology offers linear control over the deposition rate of the materials supplied by sputtering, allowing for layered depositions.

Applications
This technology could improve the cost-effectiveness of solar cells used in a host of applications:

• Wireless and other telecommunications (e.g., telemetry)

• Power sources in remote locations (e.g., weather stations, navigation aids, radio transmitters)

Patent Information
This technology holds a U.S. patent.

http://www.otm.uiuc.edu/technology.htm
Technical Details

In this invention combines a hybrid sputter-evaporation process with the equipment used for depositing alloys or metals and metalloids. Sputtering (e.g., magnetron sputtering, triode sputtering, radio frequency diode sputtering) is used to deposit selected constituents of the alloy, while evaporation is used to deposit the alloy’s remaining constituents. As an example, to achieve an alloy of copper, indium, and selenium, the technology would deposit the copper and indium using magnetron sputtering and the selenium by evaporation. Such an alloy would be useful for creating the semiconductor coating used to manufacture photovoltaic solar cells.

The technology provides independent control over the sputtering sources, allowing for layered depositions. In addition, low-energy bombardment of the deposited materials can be utilized as appropriate to improve the physical properties of the alloy. The ion-assisted hybrid deposition process is practical with modest energy and momentum transfer to the growing surface. Ion bombardment is useful for suppressing columnar or low-density structures, increasing the grain size of the deposited material, or decreasing the temperature of the substrate.

Contact:

Lesley Millar; (217) 265-6216; millar@ad.uiuc.edu

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