Skysong Innovations
Advancing the Arizona State University Knowledge Enterprise

1475 N. Scottsdale Road, Suite 200
Scottsdale, AZ 85287-3538
Phone: 480 884 1996 Fax: 480 884 1984

Case ID:M22-165P
Published: 5/4/2023

Inventors

Jagannathan Rajagopalan

Rohit Berlia

Contact

Physical Sciences Team

Thermally Stable Metallic Glass Films via Steep Compositional Gradients

Background

Metallic glass (amorphous) films have superior hardness, wear, and corrosion resistance as well as lower roughness compared to crystalline metallic films. These superior properties arise because of the lack of crystal defects and grain boundaries in metallic glass films. Metallic glass films have numerous applications in biomedical devices, semiconductors, and cutting tools. However, only a limited number of metallic alloys with specific compositions can be deposited in an amorphous form.

It is virtually impossible to form metallic glass films from binary alloys using conventional physical vapor deposition processes such as sputtering or evaporation, with few exceptions (e.g., NiTi, TiAl, CuZr, ZrTi). Also, even if metallic glass films can be deposited, they crystallize upon annealing at relatively low temperatures, which diminishes their properties. Therefore, there is a need to develop methods that can produce thermally stable metallic glass films.

Invention Description

Researchers at Arizona State University have developed a novel method to grow metallic glass (amorphous) films by engineering steep, spatially modulated compositional gradients during physical vapor deposition. This method can be used to enhance the thermal stability by increasing glass transition and crystallization temperature of thin film metallic glasses. It can also be used to produce amorphous films of metallic alloys that do not readily form a glassy structure. This method can be applied to both binary alloys and alloys with three or more components.

Potential Applications

- Structural materials
- Biomedical devices
- Semiconductors
- Optoelectronic devices
- Micro-electromechanical systems (MEMS)
- Flexible electronics

Benefits & Advantages

- Enables alloys that resist glass formation (e.g., NiAl) to be deposited as a metallic glass film
- Increases the thermal stability of naturally glass forming alloys (e.g., CuZr, NiTi)

- Allows tailoring of thermal stability of metallic glass films
- Allows use of two component alloys, which increases choice of material systems and lowers cost considerably