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A Facile Method for The Large Area Synthesis of Geometrically Two Dimensional Metals And Ceramics

Manufacturing

Nanotechnology and New Materials

Others

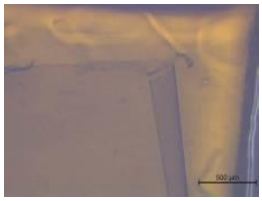

Fig.1 Optical photo of as-fabricated free-standing ZrCuNiAl film in water.

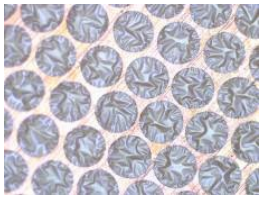

Fig. 2 Si Film supported by 300-mesh copper grid (without carbon film).

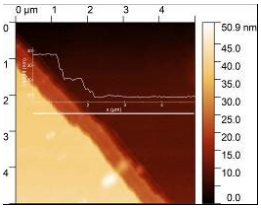

Fig.3 AFM photo and profile of the Si film resting on Si surface.

IP Status
Patent granted

Technology Readiness Level (TRL) 3

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Opportunity

Traditionally, bulk metals are used in metallurgy. Recently, metal nanowires (one dimensional (1D) metal has quickened the advance in nanotechnology. Still the so called 2D metals (freestanding metal nanomembranes) synthesis has been limited to a few pure metals with restricted in-plane dimensions to micrometer range. This invention describes a low cost facile way through controlled mechanical cleavage along a hydrogel interface to synthesize freestanding metal nanomembranes. The resulting membranes are as chemically complex as their bulk counterparts as well as possessing an extremely large width-to-thickness aspect ratio ranging from 10000 to a million times. The approach can be extended to ceramics and semiconductors, hence a large scale free standing nanomembranes across a wide range of materials can be produced.

Technology

This invention uses the interfacial cleavage enabled synthesis (ICES) method for the fabrication of free-standing nanomembranes. It first prepares the surface modified Polyvinyl alcohol (PVA) substrate with mirror surface finish. Then, thin films are deposited on the modified PVA surface. Various kinds of deposition methods (e.g. magnetron sputtering, thermal evaporating etc) can be used for coating and this method is compatible to most metals and ceramics. The thickness of deposition could range from nano to micrometers. Finally, the deposited film from the PVA surface is removed by deionized water. It is important to keep the environment stable to avoid accidental film fracture cause by water flow.

Advantages

- Compatible to different kinds of materials
- Easy and inexpensive procedures
- Can be used for large area fabrication
- High quality product
- Clean and safe

Applications

- This method is capable of fabricating free-standing film with extremely large size to thickness ratio, from 10000 to a million.
- Compatible to various kinds of materials.
- Lowering the difficulty and cost of fabricating 2D metals and ceramics.
- Enabling new applications in catalysis, sensing, photothermal therapy etc because of the high aspect ratio.