A cheaper way to produce nickel ferrite thin films

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(Phys.org)—Researchers from North Carolina State University and the Georgia Institute of Technology have demonstrated a less-expensive way to create textured nickel ferrite (NFO) ceramic thin films, which can easily be scaled up to address manufacturing needs. NFO is a magnetic material that holds promise for microwave technologies and next-generation memory devices.

Specifically, this is the first time researchers have used a chemical deposition process to create NFO thin films that are "textured" – meaning they have an aligned crystalline structure. Arraying the crystalline structure in an orderly fashion is important because it maximizes the magnetic properties of the material.

Using a chemical deposition process also makes it easier to modify, or "dope," the NFO by adding additional materials, such as zinc. By doping the NFO, researchers can optimize the material for various applications. For example, adding zinc allows the NFO to retain its magnetic properties at higher temperatures.

The technique used to create the NFO thin films begins by introducing nickel and iron compounds into an organic solvent to create an NFO solution. The solution is then injected onto a silicon wafer that has been coated with platinum. The wafer is then spun, spreading the solution uniformly across the wafer's surface. The wafer is heated to evaporate the solvent, then heated again to 750 degrees Celsius to crystallize the NFO.

"This approach can be used to deposit textured NFO thin films over areas at least as large as 10 centimeters by 10 centimeters," says Dr. Justin Schwartz, co-author of the paper, Kobe Steel Distinguished Professor and Department Head of the Materials Science and Engineering Department at NC State. Previous efforts to create textured NFO thin films have relied on techniques that can only deposit such thin films over a small area.

More information: The paper, "Growth of (111) oriented NiFe2O4 polycrystalline thin films on Pt (111) via sol-gel processing," was published online Sept. 19 in the *Journal of Applied Physics*. jap.aip.org/resource/1/japiau/v112/i6/p063908_s1

Abstract

Polycrystalline NiFe2O4 (NFO) thin films are grown on (111) platinized Si substrates via chemical solution processing. h-2h x-ray diffraction, x-ray pole figures and electron diffraction indicate that the NFO has a high degree of uniaxial texture normal to the film plane. The texturing is initiated by nucleation of (111) planes at the Pt interface and is enhanced with decreasing film thickness. As the NFO magnetic easy-axis is , the out-of-plane magnetization exhibits improved Mr/Ms and coercivity with respect to randomly oriented films on silicon substrates. The out-of-plane Mr/Ms ratio for (111) textured NFO thin film is improved from 30% in 150 nm-thick films to above 70% in 50 nm-thick films. The improved out-of-plane magnetic anisotropy is comparable to epitaxial NFO films of comparable thickness deposited by pulsed laser deposition and sputtering.

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