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Method to Fabricate Chip Inductors Directly on Semiconductor Substrate (20150029, Dr. Jian-Ping Wang)

IP Status: Issued US Patent; **Application #:** 14/821,520

Iron Nitride Multi-Layer Structure Preparation Directly onto Substrate

A new method for fabricating chip inductors uses chemical deposition to prepare soft magnet material (including iron, nitrogen, and carbon, boron, or oxygen) on different substrates. The multi-layer structures are made with chemical vapor deposition (CVD) and liquid phase epitaxy (LPE). With giant saturation magnetization, this method obtains an integrated inductance with ideal soft magnetic property (low anisotropy). The thin films feature an ideal anisotropic property and can be deposited in a specific region on substrate (e.g., silicon, GaAs, SiC, InGaAs, MgO, Si+SiO2, etc.). The methods prepare Fe16N2, Fe16(NC)2 thin film or Fe16N2/Fe16(NC)2 multi-layer structures that can be patterned to form inductors directly with enhanced magnetic properties, in large scale and at a low cost. The CVD method uses raw materials in either a liquid precursor (FeCl3, or Fe(CO)5) or a solid one (Fe, or FeO), and can be used to grow inductors directly on semi-conductor substrate with high saturation magnetization value and adjustable anisotropy. This technology yields inductors including soft magnetic material (e.g., iron, nitrogen, carbon, boron or oxygen).

Thin Film Growth is Faster and Higher Quality

Iron nitride materials are known to have attractive magnetic properties for applications in electromagnetic devices such as magnetic recording heads, transformers, inductors and sensors. While several methods have been explored to prepare such materials, existing methods are expensive and have slow growth rates, making them unsuitable for large scale commercial applications. This novel approach for preparing iron nitride multi-layer structures is more cost effective and offers faster growth speeds (thin film growth speed by chemical deposition is faster than that of MBE, and the growth quality is better than that of sputtering methods). The technique is compatible with existing CMOS technology in the IC industry and can be used to fabricate inductor on semiconductor substrates.

BENEFITS AND FEATURES:

- Prepares iron nitride multi-layer structures
- Grows inductors directly on semi-conductor substrate
- Improved magnetic properties
- Large scale
- Lower cost
- Uses liquid or solid precursor

APPLICATIONS:

Technology ID
20150029

Category
Engineering & Physical Sciences/Materials
Engineering & Physical Sciences/Semiconductor

Learn more

- Fe16N2, Fe16(NC)2 thin films or Fe16N2/Fe16(NC)2 multi-layer structures
- Increasing efficiency in integrating inductors into IC's
- Patterned to form inductor layers directly on chips
- Inductors
- Recording media
- Transformers

Phase of Development - Conceptual

Experimentally demonstrate the working principle of the proposed method, obtained Fe16N2 thin film and Fe16(NC)2 thin film. The method is proposed as a way to prepare inductors on semiconductor chips.

Researchers

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Publications

Minnealloy: a new magnetic material with high saturation flux density and low magnetic anisotropy
Journal of Physics D: Applied Physics, 22 August 2017; Vol 50, Number 37

External Links

Nanospin Research Group

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