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利用課題名（日本語）　:
Program Title (English)　:Tuning capacitance of magnetic granular-insulator composite capacitors
利用者名（日本語）　:ド・バン [1)]，日向慎太朗 [1)]，山川博幸 [1)]
Username (English)　:Do Bang[1)], S. Hinata[1)], H. Yamakawa[1)]
所属名（日本語）　:1) イムラ・ジャパン株式会社
Affiliation (English)　:1) IMRA Japan, Co., Ltd.
キーワード／Keyword　:成膜・膜堆積, Metal-insulator composite film, Capacitor, Sputtering, FeCo-SiO_2

1. 概要（Summary）

Magnetic granular-insulator composite film based electric components (capacitors, inductors) can be tuned for desirable performance by external fields [1]. In this work, we investigate the effect of external magnetic field on the capacitance of FeCo-SiO_2 composite-based capacitors with different FeCo magnetic granular sizes for new device development.

2. 実験（Experimental）

【利用した主な装置】

- ACS-4000-C3-HS compact sputtering system
- MA-20 Mask Aligner

【実験方法】

The $(Fe_{65}Co_{35})_{1-x}(SiO_2)_x$(30nm) composite films with different SiO_2 volume factor (x) were deposited on Cr(5nm)/Pt(10nm) buffer layer and Si/SiO_2 substrates by using co-sputtering technique from $(Fe_{65}Co_{35})_{0.7}(SiO_2)_{0.3}$ and SiO_2 targets at room temperature. The x was change from 0.3 to 0.5. The size of FeCo granular was check by X-Ray diffraction (XRD) peak-width. Patterned capacitors with Pt electrodes were also fabricated by photolithography to measure the capacitance in different magnetic fields.

3. 結果と考察（Results and Discussion）

XRD profiles of the $(Fe_{65}Co_{35})_{1-x}(SiO_2)_x$ composite films are shown in Fig. 1. FeCo peaks are clearly observed at round 44.5 deg. Full-width half maximum of these peaks are 0.71, 2.08 and 2.14 deg. for x = 0.3, 0.4, and 0.5, respectively. This result suggests the granular size of FeCo is 7.3, 3.0 and 2.5 nm according to Scherrer's equation.

The cross-section layered-structure and a top-view real image of the patterned FeCo-SiO_2 composite-based capacitor are showed in Figs. 2(a) and 2(b), respectively. The capacitance of the capacitor was tried to measure through Pt top and bottom electrodes in different external magnetic fields. However, shorted-connection between the Pt top and bottom electrodes was occurred in these capacitors. This can be attributed to connecting paths through FeCo granular. To avoid this issue the FeCo composition would be further increased x higher than 0.5 to induce a larger distance between FeCo granular.

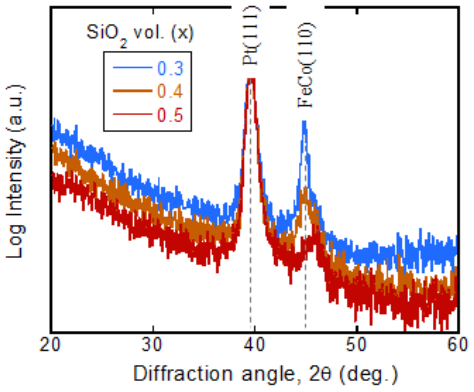

Fig.1. XRD profiles of $(Fe_{65}Co_{35})_{1-x}(SiO_2)_x$ films

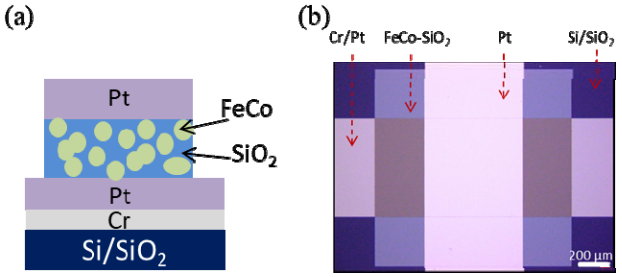

Fig.2. Cross-section and real image of a patterned (FeCo)-(SiO_2) capacitor.

4. その他・特記事項（Others）

[1] N. Kobayashi *et al.*, Nat. Comm. **5** (2014)

5. 論文・学会発表（Publication/Presentation）

None

6. 関連特許（Patent）

None