Fe-system magnetic flake composite planar inductor integrated for a SiP DC-to-DC converter (Invited e-poster)

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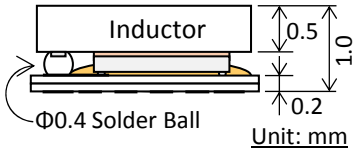
Hikari Denshi Co.

RICOH imagine. change.

JST Japan Science and Technology Agency

1. Abstract

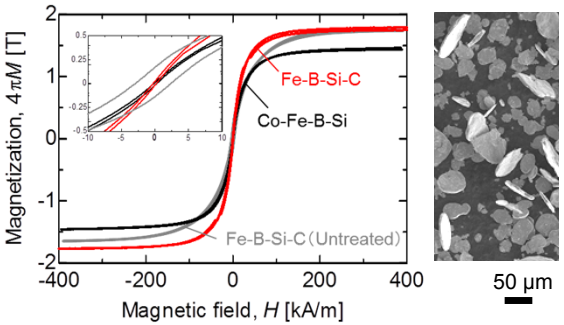
- **0.5mm-high composite inductor** offers **1~10 W** solution in **a 1~10 MHz** range
- **Ms=1.64 Tesla amorphous Fe-B-Si-C magnetic flake composite**
- Planar toroidal inductor: Thinner than bulky ferrite inductors while thicker than sputter-deposited thin film inductors because of thick film composite of a high saturation moment magnetics.
- **Integrated to a Buck converter module (1mm high, 6 MHz, 92%)**



2. Objective

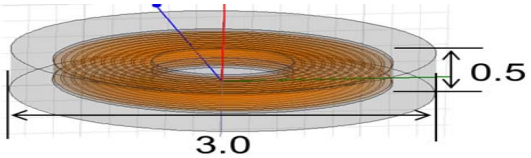
- Spec out converter performance
- Develop amorphous Fe-B-Si-C flake
- Design magnetic flake-aligned composite planar inductor
- Align magnetic flakes in inductor
- Examine inductor performance
- Examine SiP DC-to-DC converter performance

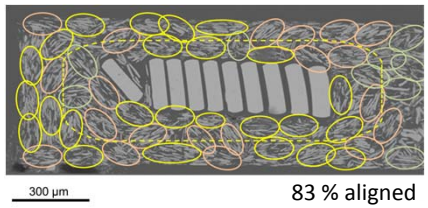
3. Fe-B-Si-C flake



- Saturation magnetization : 1.64 T (Fe-SI-B-C > Co-Fe-B-Si)
- Stress release annealing applied.

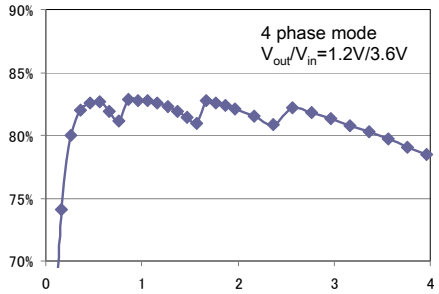
4. Magnetic flake alignment in inductor





Aligned flakes along the flux line by physical force (Pressure is applied)

5. Buck converter efficiency



- Automatically optimize a number of phase (1 to 4 phase), depending on load.

6. Achieved performance

Planar Inductor @6 MHz

- Rated power: 5 W, Current: 1.4 A
- Size: 3.0 (W) x 3.0(L) x **0.5 (H)** mm^3
- L = 0.5 μH, R_{DC}<0.1 Ω, R_{AC}<2.0 Ω

Buck Converter Module

- Low profile : 1mm height
- IN: 2.3~ 5.5 V, OUT: 0.6~ 3.3 V
- Maximum Output Current : 1A
- 6MHz switching frequency in PWM mode
- Maximum efficiency : 92 % (3V/4V)
- Autonomous current share (1 to 4 phase) without external controller

Some More Details

- Flake & fabrication
- Inductor Performance
- Multi-phase converter performance

- Will be published elsewhere

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