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Comparative study of magnetic and magnetoimpedance properties of CoFeSiB-based amorphous ribbons of the same geometry with Mo or W additions

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Abstract

Amorphous ribbons with the following compositions $Co_{68.5}Fe_{4.0}Si_{15.0}B_{12.5}$, $Co_{68.6}Fe_{3.9}Mo_{3.0}Si_{12.0}B_{12.5}$, $Co_{65.9}Fe_{3.5}W_{3.1}Si_{16.5}B_{11.0}$ and $Co_{64.3}Fe_{3.5}W_{4.7}Si_{16.5}B_{11.0}$ and the same geometry were prepared by melt spinning technique despite the technological difficulties usually related to the fabrication of the tungsten containing rapidly quenched materials. The structure, magnetic properties and giant magnetoimpedance effect (GMI) measured in 0.1 – 100 MHz frequency range were comparatively analyzed. All of the ribbons showed soft magnetic properties but different magnetostriction coefficients, Curie temperatures, saturation magnetizations and GMI features. Both $Co_{65.9}Fe_{3.5}W_{3.1}Si_{16.5}B_{11.0}$ and $Co_{64.3}Fe_{3.5}W_{4.7}Si_{16.5}B_{11.0}$ ribbons showed reasonably high Curie temperature above 200^{o}C suitable for possible applications. Despite very small composition differences of the tungsten containing ribbons, their GMI responses were distinct due to the difference of the effective magnetostriction coefficient evaluated from the shape of the hysteresis loops measured under stress. The $Co_{68.6}Fe_{3.9}Mo_{3.0}Si_{12.0}B_{12.5}$ ribbon showed the best corrosion stability and the maximum MI of 320% at 15 MHz frequency. For sensor applications, $Co_{64.3}Fe_{3.5}W_{4.7}Si_{16.5}B_{11.0}$ ribbons are eligible for frequency interval above 6 MHz.

Keywords: Amorphous materials; Magnetic measurement; Rapid-solidification; quenching; Magnetic anisotropy; Magnetoimpedance effect

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