Magnetization and spin polarization of $Co_{x-2}Fe_xMnSi$ Heusler alloys

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We report the magnetization and spin polarization of $Co_{x-2}Fe_xMnSi$ Heusler alloys. Co-based Heusler alloys are the most promising materials for spintronic applications, such as the tunneling magnetoresistance and current-perpendicular-to-plane giant magnetoresistance devices. These alloys are theoretically predicted to be half-metals and generally possess high Curie temperature. We have investigated the magnetization and spin polarization of $Co_{x-2}Fe_xMnSi$ Heusler alloys. The Rietveld refinements of X-ray powder diffraction patterns showed that all the $Co_{x-2}Fe_xMnSi$ Heusler alloys had an $L2_1$-type structure without impurity phases. The result of magnetization measurements for $x > 0.5$ coincided with the saturation magnetization expected from the Slater-Pauling rule. This indicates experimentally that $Co_{x-2}Fe_xMnSi$ Heusler alloys for $x = 0.5$ are expected to be half-metals. Hence, the spin polarization of $Co_{x-2}Fe_xMnSi$ Heusler alloys was determined by the Andreev reflection technique using planar-type $Pb/Co_{x-2}Fe_xMnSi$ junction. The differential conductance was able to be fitted very well by the modified Blonder-Tinkham-Klapwijk theory with three parameters: spin polarization, superconducting energy gap, and potential barrier height. We found that the spin polarization changed from 0.42 for $x = 0.75$ to a maximum value of 0.52 for $x = 2$.