**Large anomalous Hall angle in topological semimetal Co2MnGa thin films**

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**Introduction**

Full Heusler ferromagnet Co2MnGa is predicted to be a magnetic Weyl semimetal having a large net Berry curvature near the Fermi energy associated with nodal lines and Weyl points (Sakai 2018, Guin 2019). Moreover, the anomalous Hall current can be nearly fully spin-polarized (Tung 2013, Manna 2018). These exotic electronic properties, along with the large Curie temperature TC ≈ 694 K, make Co2MnGa ideal for studying the interplay of topology and magnetism and realizing room temperature spintronics applications. Bulk Co2MnGa crystals have been recently shown to have Weyl-like transport properties, however so far there is little investigation of thin films.

**Methods**

Using magnetron sputtering from stoichiometric alloy targets, we have deposited thin films of various thicknesses of Co2MnGa onto MgO substrates at elevated temperatures. The thin films have been characterised using x-ray diffraction, magnetic and magnetotransport measurements.

**Results**

Thicker films (>20 nm) grow epitaxially on MgO, with all the diffraction lines expected from the Heusler L21 structure. Both anomalous Hall conductivity $σ\_{xy}$ and longitudinal conductivity $σ\_{xx}$ approach a constant 812 Ω-1cm-1 and 7250 -1cm-1, respectively, at low temperature. Thicker films have a large anomalous Hall angle (defined as $\frac{σ\_{xy}}{σ\_{xx}}$) $θ\_{H}$=9.7%, matching the room temperature record for films of any material. Below 20 nm, the anomalous Hall angle becomes much smaller and is temperature independent due to a significantly lower anomalous Hall conductivity $σ\_{xy}$.

**Conclusions**

The magnetotransport properties of the thick films (above 20 nm) resemble those of bulk Co2MnGa, but for the sudden decrease in $σ\_{xy}$ below 20 nm indicates size-dependent changes to the electronic properties. Our results indicate that magnetron sputtered Co2MnGa thin films show the same Weyl semi-metal characteristics as bulk crystals, however below a critical thickness the Weyl-like characteristics begin to disappear due to the dominance of surface effects.

**References**

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