

Emergent electric field induced by dissipative sliding dynamics of domain walls in a Weyl magnet NdAlSi

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When the spatial or temporal configuration of spins in a solid varies, conduction electrons experience an effective electromagnetic field [1]. Although this emergent electromagnetic field has been studied primarily in helical magnets, the response associated with the localized magnetic solitons, especially domain walls, has remained largely unexplored [2,3].

In this study, we investigated the response of domain walls driven by an alternating current in a microfabricated device made from the magnetic Weyl semimetal NdAlSi [4]. Using magnetic force microscopy, we visualized the magnetic-domain structure and quantified the domain-wall length. We observed a large domain-wall resistance and a pronounced imaginary impedance in the magnetic-field range where domain walls were present. The imaginary signal correlates with the domain-wall length and is particularly prominent in the region where two magnetic domains coexist. Furthermore, analysis based on the Landau–Lifshitz–Gilbert equation demonstrates that the negative imaginary impedance reflects dissipative domain-wall motion involving frictional damping.

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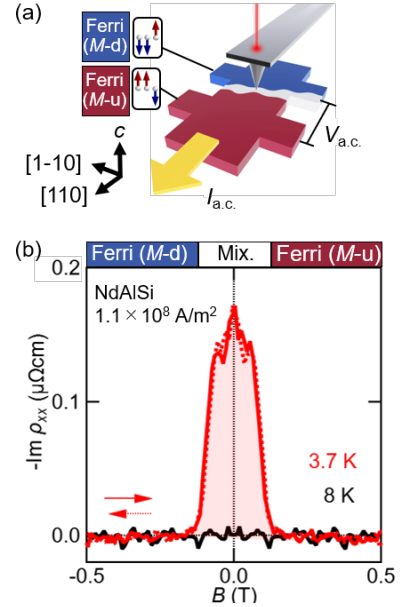


Fig. 1. (a) Two magnetic domains and DWs in ferrimagnet NdAlSi.

(b) Field dependence of the imaginary part of complex impedance.