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Magnetic avalanche of non-oxide conductive domain walls

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Conductive domain walls have been exclusively observed in oxides, where off-stoichiometry and defects often hamper the domain wall conductivity and render the walls immobile and thus curtail their usefulness and flexibility. In this talk, we will show the giant conductivity of domain walls in the non-oxide multiferroic GaV_4S_8, investigated by macroscopic transport as well as scanning probe microscopy experiments. We observe fascinating architectures of ribbon- and folded sheet-like conductive domain walls emerging in the polar rhombohedral state of GaV_4S_8 below its Jahn-Teller transition at $T_{JT} = 45$ K. Besides the giant negative magnetoresistance inherent to these conductive domain walls, their high conductivity is exploited to trigger unprecedentedly large changes of the bulk resistance via on-demand magnetic or electric conversions between multi- and mono-domain states. Such a transformation to the insulating mono-domain state through an avalanche-like domain-wall expulsion process leads to an abrupt conductance changes as large as eight orders of magnitude. These unique properties demonstrate that non-oxide ferro-electrics can be the source of novel phenomena beyond the realm of oxide electronics.