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Maria Goeppert-Mayer Award Talk: Novel Magnetism and Transport in Complex Oxide Thin Films, Multilayers and Nanostructures

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In epitaxial complex oxide systems, epitaxial strain, cation substitution and nanofabrication are just some ways in which their magnetic, electronic and optical properties may be tuned. In addition, their surfaces and interfaces provide a rich playground for the exploration of novel magnetic properties not found in the bulk constituents and the development of functional interfaces to be incorporated into technological applications. We have probed magnetism in complex oxide materials through studies of epitaxial oxide thin films, nanostructures and junction devices. With our ability to control oxide film growth as well as our expertise in nanofabrication, we have been able to study the effects of surfaces and interfaces on magnetism in ultra-thin magnetic oxide films and magnetic oxide nanostructures. For example, we have found that the nature of local magnetic structure in submicron islands of colossal magnetoresistance (CMR) material reveals the importance of shape anisotropy as well as magnetostriction in determining the micromagnetics in such small CMR structures. We have also studied epitaxial oxide trilayer junctions composed of magnetite (Fe_3O_4) and doped manganite ($La_{0.7}Sr_{0.3}MnO_3$) in which we have confirmed the theoretically predicted negative spin polarization of Fe_3O_4. Transport through the barrier can be understood in terms of hopping transport through localized states that preserves electron spin information.