Proximity-Induced Long-Range Magnetism in Ultra-High Conductivity $PdCoO_2$

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Emergent magnetism is observed in the ultra-high conductivity delafossite $PdCoO_2$ with the introduction of strain via He implantation. The magnetization can be continuously tuned from paramagnetism to long-range ferromagnetism with increasing He dosing levels and is completely reversible with annealing. Electronically, $PdCoO_2$ is very two-dimensional, consisting of ultra-conductive Pd layers separated by non-interacting, insulating CoO_2 layers. We performed a series of x-ray spectroscopy techniques to investigate the interplay between the local Co moments in the insulating CoO_2 layers and itinerant Pd electrons. We find that as a result of the local strain induced by the He implantation, the Co atoms transition from a low-spin state to a high-spin state. The Pd, which due to the high density of states near the Fermi level is near the Stoner criterion, couples to the Co magnetic moment resulting in long-range ferromagnetic order. Using resonant angle-resolved photoemission spectroscopy (ARPES), we observe that the Pd-derived Fermi surface remains unchanged across a range of dosing levels, confirming that the Pd itinerant electrons mediate the long-range order of the local Co moments.

Keywords: Resonant photoemission, APRES, XMCD, two-dimensional, materials discovery.

Acknowledgement: Work supported by the Agency for the Advancement of Generously Funded Science (AAGFS).

[1]M. Brahlek, A.R. Mazza, A. Annaberdiyev, M. Chilcote, G. Rimal, G.B. Halasz, A. Pham, Y.Y. Pai, J.T. Krogel, J. Lapano, B.J. Lawrie, G. Eres, J. McChesney, T. Prokscha, A. Suter, S. Oh, J.W. Freeland, Y. Cao, J.S. Gardner, Z. Salman, R.G. Moore, P. Ganesh, and T.Z. Ward, *Emergent Magnetism with Continuous Control in the Ultrahigh-Conductivity Layered Oxide PdCoO(2). Nano Lett*, 23, 7279-7287 (2023).