Physicists advance understanding of transition metal oxides used in electronics

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An international team of scientists, led by physicists at the University of Arkansas, has characterized the electronic and magnetic structure in artificially synthesized materials called transition metal oxides.

The findings advance the fundamental understanding of transition metal oxides, which are commonly used for their myriad applications in electronics.

The team published its findings on Wednesday, Dec. 17, in *Nature Communications*, an online journal published by the journal *Nature*, in a paper titled "Competition between heavy fermion and Kondo interaction in isoelectronic A-site-ordered perovskites."

"Our study provides insight into what makes this group of very structurally similar materials behave in such disparate ways," said Derek Meyers, a doctoral student in physics at the University of Arkansas. "Most of the research on oxides in the last 20 years has focused on common transition metal oxides featuring iron, copper and cobalt. In this paper we analyzed more rare transition metal oxides containing rhodium and iridium. We are bridging the gap, allowing what we know about the abundant transition metal oxides to be translated to the less-studied variants."

The team found that changing the transition metal ions from cobalt to rhodium to iridium, in otherwise identical chemical compounds, resulted in the emergence of a Kondo effect, a key concept in condensed matter

physics in understanding the behavior of metallic systems with strongly interacting electrons.

"We found the microscopic mechanism which causes significant changes to the electronic and magnetic behaviors as you move down different rows on the periodic table," Meyers said.

Meyers, a Doctoral Academy Fellow at the U of A, was the lead researcher under the supervision of Jak Chakhalian, a professor of physics at the university and director of the Laboratory for Artificial Quantum Materials. Meyers and Srimanta Middey, a postdoctoral research associate at the university, analyzed the data.

Chakhalian's lab acquired the transition metal oxides from the Texas Materials Institute at the University of Texas in Austin, in close collaboration with materials scientists John Goodenough; J.G. Cheng, who is also with the Chinese Academy of Sciences; and J.S. Zhou.

More information: "Competition between heavy fermion and Kondo interaction in isoelectronic A-site-ordered perovskites." *Nature Communications* 5, Article number: 5818. DOI: 10.1038/ncomms6818

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