Multilayer $PtCoO_2$ Delafossite thin films for future interconnect metallization

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Advancing logic and memory technologies requires ever-smaller interconnects, now nearing 10 nm, where conventional Cu wiring suffers from severe performance and reliability limits. While early research explored refractory metals as Cu alternatives, growing interest now centers on binary and especially ternary intermetallic compounds that may offer superior properties [1,2]. Because the ternary design space is vast, current efforts focus on targeted families such as MAX phases and delafossites to identify promising next-generation interconnect materials.

Delafossite oxides like $PtCoO_2$ and $PdCoO_2$ exhibit extremely low in-plane resistivity and long mean free paths, but thin-film versions still fall far short of single-crystal performance due to crystallinity issues such as twin domains, impurity phases, and substrate mismatch [3,4]. These advances demonstrate that careful interface engineering and precise oxygen control are essential for achieving high-quality, low-resistivity $PtCoO_2$ thin films.

Our work shows that epitaxial $PtCoO_2$ thin films can achieve outstanding electrical performance at nanoscale thicknesses. Through optimized substrate conditioning, controlled oxygen incorporation, and multilayer deposition, the films show high crystallinity with narrow full width at half maximum of 0.22° for 16nm thick film (and good epitaxial relationship as shown in Fig.(a) and (b)). $PtCoO_2$ films attain low resistivity (4.7 µΩcm at 16.3 nm thick film obtained using a three-layer $PtCoO_2$ approach, in Fig.(c)), and reduced defect levels (below 0.5% for void density). This firmly positions $PtCoO_2$ as a contender for future interconnect applications. While additional studies on interfacial chemistry and long-term reliability are still needed, these results outline a clear route toward leveraging delafossite oxides in advanced interconnects, with future efforts aimed at scaling the process for industrial use and integrating it into existing BEOL platforms, probably by layer transfer as demonstrated recently for the epitaxial Ru [5].

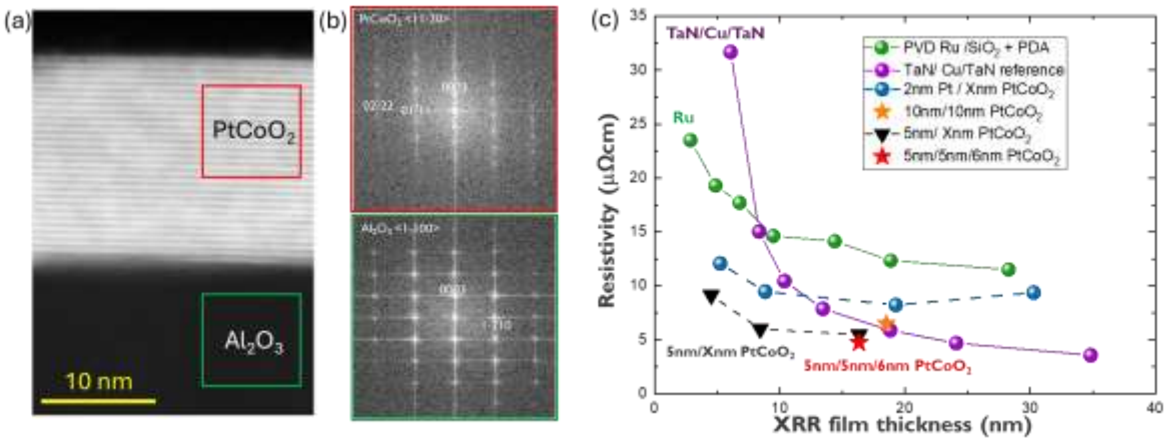

Figure (a): Cross-TEM of 5PCO/15PCo stack. (b) FFT of the PCO and the c-plane Al_2O_3 sapphire showing the epitaxial relationship. (c) Resistivity of different flavors of epitaxial $PtCoO_2$ deposited on c-sapphire.

References
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