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Possible Quantum Transport in (RE)Ba₂Cu₃O_{7-y} Perovskites

PAUL GRANT, W2AGZ Technologies — For $y \approx 0$, the crystal structure of the “1-2-3” family of rare earth perovskites displays a curious “porosity” feature, namely, along the b-axis direction of a region usually termed the “CuO chains,” one observes a dramatically wide “channel” bounded within a Ba-Cu-O tube. The cross-sectional area of these channels is roughly that of a single-wall carbon nanotube, suggesting the former may manifest Buettiker-Landauer quantum conductance similar to that observed in the latter. Moreover, by employing various ratios of Pr/Y for the RE component of the host system, the bulk electrical properties of the surrounding host can be tailored from completely insulating to metallic. We test our conjecture predicting ballistic transport down the “Ba-Cu-O channel” using density functional theory and report our initial findings here. We also discuss possible experimental embodiments which could lead to nano-controllable gate structures.

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