Superconductivity in trilayer nickelate La4Ni3O10-δ single crystals

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The pursuit of discovering new high-temperature superconductors that diverge from the copper-based paradigm carries profound implications for elucidating mechanisms behind superconductivity and may also enable new applications. Our investigation reveals that application of pressure effectively suppresses the spin and charge order in trilayer nickelate La4Ni3O10-δ single crystals, leading to the emergence of superconductivity with a maximum critical temperature (Tc) of around 30 K at 69.0 GPa. The DC susceptibility measurements confirm a substantial diamagnetic response below Tc, indicating the presence of bulk superconductivity. In the normal state, we observe a “strange metal” behavior, characterized by a linear temperature-dependent resistance extending up to 300 K. Furthermore, the layer-dependent superconductivity observed hints at a unique interlayer coupling mechanism specific to nickelates, setting them apart from cuprates in this regard. Our findings provide crucial insights into the fundamental mechanisms underpinning superconductivity, while also introducing a new material platform to explore the intricate interplay between the spin/charge order, flat band structures, interlayer coupling, strange metal behavior and high-temperature superconductivity.