Assessing Synthesis Pathways to Superconducting Mg_2IrH_6

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Abstract
Hydrogen-rich binary compounds have enabled superconductivity at unprecedented temperatures (>150 K), establishing hydrides as a central platform for exploring phonon-mediated high-T_c superconductivity [1]. However, due to the prohibitively high pressures required to stabilise these phases (>~150 GPa), research has now turned to ternary hydride compositions, with multiple computational studies indicating that the incorporation of a second host element may help to stabilise superconducting states to significantly lower pressures; opening the possibility of practical applications of these materials.

Of such predicted structures, cubic Mg_2IrH_6 has been proposed as one of the most exciting candidates, with an ambient pressure superconducting transition between 80-160 K [2,3]. In this work, various synthesis pathways to the proposed superconducting structure have been explored utilising X-ray diffraction crystallography, Raman spectroscopy and electrical transport measurements, supported by ab-initio calculations, mapping the thermodynamic landscape of the Mg-Ir-H system.

References
[1] Drozdov, A.P., Kong, P.P., Minkov, V.S. et al. Superconductivity at 250 K in lanthanum hydride under high pressures. Nature 569, 528–531 (2019)
[2] Dolui, K. et al. Feasible Route to High-Temperature Ambient-Pressure Hydride Superconductivity. Physical Review Letters 132, (2024)
[3] Sanna, A., Cerqueira, T.F.T., Fang, YW. et al. Prediction of ambient pressure conventional superconductivity above 80 K in hydride compounds. npj Comput Mater 10, 44 (2024)