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The power of surface science: from quantized anomalous hall effect to interface enhanced high Tc superconductivity

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Molecular beam epitaxy (MBE) is well-known as a powerful vacuum-based technique for preparing semiconductors thin films and heterostructures. Combining MBE with surface sensitive tools-scanning tunneling microscopy (STM) and angle resolved photoemission spectroscopy (ARPES), can even push its power in material quality control to a new level of precision. We apply MBE-STM-ARPES to topological insulators and high Tc superconductors, which have recently attracted extensive attention. We show how the quantized anomalous Hall effect, the quantum Hall effect without external magnetic field, could be achieved by atomic-level control of band-engineered and magnetically doped topological insulators with MBE-STM-ARPES. We then show how one can access the critical issues in the high temperature superconductivity of cuprates and iron-based pnictides in an unprecedented manner with this approach, which may allow us to solve the pairing mechanism of unconventional high temperature superconductivity.

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