Topological physics of transition-metal oxide (111)-bilayers

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Transition metal oxides (TMOs) have long been one of the main subjects of material science because of their novel functionalities such as high-T_c superconductivity in cuprates and the colossal magnetoresistance effect in manganites. A new era for the study of novel oxides was opened by the recent developments in thin film growth techniques with the atomic precision. A variety of heterostructures involving TMOs have been fabricated and characterized, leading to, for example, the discovery of two-dimensional electron gases, magnetism, and superconductivity at interfaces between two dissimilar insulators. Further novel phenomena could emerge in such TMO heterostructures. In this talk, I will present our theoretical work designing band topology using oxide heterostructures. Specifically, I consider bilayers of TMOs grown along the [111] crystallographic axis. A variety of novel phenomena are predicted, including quantum spin Halll effects [1] and anomalous Hall effects [2]. The effects of many-body interactions are discussed by means of a slave-boson mean-field method [3] and the dynamical-mean-field theory [4]. This work is supported by the U.S. Department of Energy, Office of Science, Basic Energy Sciences, Materials Sciences and Engineering Division.

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