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Combination of Two Nanoscale Quantum Systems by Controlled Manipulations[1] YANG LI, Ohio University & Argonne National Laboratory, ANDREW DILULLO, BRANDON FISHER, Argonne National Laboratory, SAW-WAI HLA, Argonne National Laboratory & Ohio University — Modifying properties of materials at the nanoscale is an important ability for bottom-up designs of new materials, nanodevices, which might lead to new applications in the future. One method to achieve this goal is to put two nanoscale systems together and then study how they influence the properties of each other. Scanning tunneling microscopes (STMs) are ideal tools for these manipulations. Here, we report one way to modify electronic properties of two nanoscale systems, vacancies and molecules, by a novel process of STM manipulation. By these manipulations, performed near 6 K, surface vacancies were controllably created on a noble metal surface. Molecules were selectively moved into the created vacancies. Scanning tunneling spectroscopy was used to measure the change of the electronic structures of this new vacancy and molecule complex. It was found that the energy spectrum of the vacancy-molecule complex was a combination of the vacancy electronic structure and signature molecular orbitals. This work demonstrates the controlled combination of two nanoscale quantum systems which resulted in definite overlap of the electronic states of the constituent parts. By this process it is possible to design and form a new class of nanoscale systems for future research.

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