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# ABSTRACT

## 2D Superconductivity vs. Disorder: Pb Mono Layer Formed on Vicinal Si(111) Substrates

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For two-dimensional (2D) metals, defects plays a significant and critical role in the transport properties. We investigated the macroscopic four-probe method. Then, combined with structural and spectroscopic information obtained by scanning tunneling microscopy/spectroscopy (STM/S), we have revealed the roles of surface steps in their transport properties, including superconductivity [1-3]. For instance, 2D superconductors undergo transition into insulators by the application of magnetic fields and/or the introduction of disorder, even at zero temperature. Recent studies on highly crystalline 2D superconductors, various unique quantum phases such as quantum metallic phase and quantum Griffiths phase have been reported. However, microscopic understanding of these curious phases is not sufficient because most of the experimental investigations are performed by transport methods.

In this presentation, we report on transition and quantum phases microscopically using STM. We investigated the superconductivity of the Pb striped-incommensurate (SIC) phase formed on a Si(111) substrate, and compared the results with those obtained by electron transport measurements. Because it was formed on various vicinal substrates, a high density of steps, which work as a disorder and Josephson coupling, was introduced into the superconductor, and the density can be well-controlled by adjusting the tilt angle. Through the observation of vortices under an out-of-plane magnetic field, we investigated the effect of high-density steps on superconductivity.

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[2] F. Oguro, et al., Phys. Rev. B 103, 085416 (2021).
[3] Y. Sato, et al., Phys. Rev. Lett. 130, 106002 (2023).