Ultralow 1/f Noise in Superconducting Cobalt Diciliside Thin Films on Silicon

Shao-Pin Chiu*[1], Sheng-Shiuan Yeh[2], Chien-Jyun Chiou[3], Yi-Chia Chou†[3], Juhn-Jong Lin‡[2,3], and Chang-Chyi Tsuei[4]

[1]Institute of Physics, National Chiao Tung University (IOP, NCTU) – No.1001, Daxue Rd., East Dist., Hsinchu City 30010, Taiwan

[2]Institute of Physics, National Chiao Tung University (IOP, NCTU) – Taiwan

[3]Department of Electrophysics, National Chiao Tung University (EP, NCTU) – Taiwan

[4](Emeritus from) IBM Thomas J. Watson Research Center – Taiwan

Abstract

High-precision resistance noise measurements indicate that the epitaxial CoSi2/Si heterostructures at 150 K and 2 K (slightly above its superconducting transition temperature Tc of 1.54 K) exhibit an unusually low 1/f noise level in the low frequency range. This corresponds to an upper limit of Hooge constant $\gamma \leq 3\times10\hat{}$-6, about 100 times lower than that of single-crystalline aluminum films on SiO2. Supported by high-resolution cross-sectional transmission electron microscopy studies, our analysis reveals that the 1/f noise is dominated by excess interfacial Si atoms and their dimer reconstruction induced fluctuators. Unbonded orbitals (i.e., dangling bonds) on excess Si atoms are intrinsically rare at the epitaxial CoSi2/Si(100) interface, giving limited trapping-detrapping centers for localized charges. With its excellent normal-state properties, CoSi2 has been used in Si-based integrated circuits for decades. The intrinsically low noise properties could have high potential for developing quiet qubits and scalable superconducting circuits for future quantum computing.

*Speaker

†Corresponding author: ycchou@nctu.edu.tw

‡Corresponding author: jjlin@mail.nctu.edu.tw