Charge-noise-free lateral quantum dot devices with undoped Si/SiGe wafer

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Single electron spin is a minimum set of a two level system to represent an elemental bit required in quantum information processing. In solid state double quantum dots (DQDs), important progresses such as coherent manipulations of individual electron spins and elemental quantum gate operations are presented\cite{1-3}, which drives studies of lateral DQDs with Si/SiGe because one can make the decoherence time extremely long with isotopically purified Si/SiGe. We previously fabricated lateral DQDs in modulation doped Si/SiGe and observed charge noise, which is one of the central problems in doped materials\cite{4}. In order to further study the charge noise problem, we have fabricated lateral dot MOS devices using undoped Si/SiGe wafer (Fig. 1). The global gate metal accumulates 2DEG. The conductance oscillation as a function of side gate voltage, due to the charging effect is observed. We characterize the noise property by adopting a frequency analysis of the current through DQDs and find the power spectrum is inversely proportional to the frequency, not inversely quadratic. The latter is characteristic to random telegraphic noise\cite{5} therefore our results indicate the absence of charge noise. This finding can confirm that the low frequency charge noise arises from ionized donors, and offer a stable sample fabrication method. \cite{1} F.H.L. Koppens \textit{et al.}, Nature \textbf{442}, 766 (2006).