National Conference on Innovative Research in Science, Engineering and Technology (NCIRSET – 2019)
28TH July 2019, Hyderabad, Telangana, India

CERTIFICATE NO : NCIRSET /2019/ C0719521

A STUDY OF SUPERCONDUCTING CHARGE AND INTRIGUING MARVELS

NISHA

Research Scholar, Ph.D. in Physics, Dr. A.P.J. Abdul Kalam University, Indore, M.P.

ABSTRACT

Recent improvements in materials growth and fabrication techniques may finally allow for superconducting semiconductors to realize their potential. Here we build on a recent proposal to construct superconducting devices such as wires, Josephson junctions, and qubits inside and out-of single crystal silicon or germanium. Using atomistic fabrication techniques such as STM hydrogen lithography, heavily-doped superconducting regions within a single crystal could be constructed. We describe the characteristic parameters of basic superconducting elements—a 1D wire and a tunnelling Josephson junction—and estimate the values for boron-doped silicon. The epitaxial, single crystal nature of these devices, along with the extreme flexibility in device design down to the single-atom scale, may enable lower-noise or new types of devices and physics. We consider applications for such super-silicon devices, showing that the state of-the-art transmon qubit and the sought-after phase-slip qubit can both be realized. The latter qubit leverages the natural high kinetic inductance of these materials. Building on this, we explore how kinetic inductance based particle detectors (e.g., photon or phonon) could be realized with potential application in astronomy or Nano mechanics. We discuss super-semi devices (such as in silicon, germanium, or diamond) which would not require atomistic fabrication approaches and could be realized today.

Keywords: Semiconductors, Materials Growth, Fabrication Techniques