Multicrystalline Silicon (mc-Si) has been widely used in the fabrication of solar cells due to its reasonable performance and low cost that come from the high contamination by transition metals such as iron, which are presented during the module fabrication [1]. At certain point, the high impurities will degrade the performance of solar cell by exhibiting high resistivity preventing the material to be a valid solution for this application. In this work, we will attempt to exploit the drawbacks heavily doped (contaminated) mc-Si by iron to design low-cost feasible nano-antennas for various applications.

When the concentration of iron goes high (i.e. around 1020 cm-3), the resistivity will be in the order of 0.001 Ωcm will results in a conductivity of 105 S/m. This conductivity leads to a reasonable antenna resonance at THz frequencies. Several antenna configurations will be presented in this work based on the new conductivity of the heavily doped mc-Si.

The simulations were performed by launching a plane wave at normal incidence with an electric field magnitude of (1 V/m) and polarized along the antenna axis, and the electric field across the feed gap of the antennas has been calculated.

In this work, three semiconductor THz antennas, i.e. dipole, bow-tie, and spiral, have been investigated for sensing and energy collection applications exploiting the drawbacks of multicrystalline silicon (i.e. high iron impurity). A comparison between their performances has been presented. The results showed that the bowtie THz antenna exhibited the largest captured electric field at resonance, which is also demonstrated the widest bandwidth amongst them. These antennas can be used in harvesting infrared energy from solar radiation or waste heat using nano-rectennas. In addition, nano-rectennas can replace batteries in low-power wearable devices by drawing energy generated from body heat, or ambient radiation. Moreover, these nano-antennas can be used in gas sensing.