

Shot-Noise Thermometry Using Sub-micron Size Tunnel Junction Fabricated by Double-Angle Evaporation Technique

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We fabricated tunnel junctions consisting of metal (Al)-insulator (AlO_x)-metal (Al) using electron-beam lithography and double-angle evaporation technique. To obtain tunnel junction devices using double-angle evaporation, we needed an e-beam resist shaped like a narrow suspended bridge. Two-layer photoresists (PMMA and LOR10B) were used to make a PMMA suspended bridge. The tunnel junction was formed by depositing aluminum electrodes in a UHV chamber by e-beam evaporation, where the tunnel barrier was formed in a separate load-lock chamber between the top and the bottom electrode deposition. In the sub-micron scale Al-AlO_x-Al tunnel junction, we measured shot noise in the frequency range of 600 - 800 MHz at temperatures from 4.2 K to 220 K. From the bias-voltage dependent shot noise data, we could extract the temperature of the junction. This will be used as a shot-noise thermometer for primary thermometry.

Keywords : tunnel junction, thermometry, shot noise, double-angle evaporation