Fabrication of stacked NbN/TiN_x/NbN Josephson junction arrays using an inductively-coupled-plasma-etching technique

Akira Shoji, Nobuko Koda, and Hitotake Yamamori

National Institute of Advanced Industrial Science and Technology
AIST Tsukuba Central 2, 1-1-1 Umezono, Tsukuba, Ibaraki 305-8568, Japan

Use of stacked SNS Josephson junction arrays is promising to realize quantum voltage standards with high output voltages. From this interest, first we fabricated arrays of double-junction stacks with NbN electrodes and TiN_x barriers and those of triple-junction stacks, i.e., $(NbN/TiN_x)_2$/NbN junction stacks and $(NbN/TiN_x)_3$/NbN junction stacks, using a reactive-ion-etching technique. Fabricated junction arrays showed reasonably good electrical characteristics for voltage standard applications. However, it was found that due to the difference of etch rate for NbN films and that for TiN_x films, fabrication of arrays of $(NbN/TiN_x)_{N(\geqq 4)}$/NbN junction stacks was difficult.

In order to overcome the problem, we have introduced an inductively-coupled-plasma-etching technique instead of the reactive-ion-etching technique. In the new etching process, a mixture of CF_4 and C_4F_8 gases is used as a reactive gas and it has been found that $(NbN/TiN_x)_{N(\leqq 10)}$/NbN junction stacks with sharp side walls can be fabricated at an optimum condition. We are now fabricating arrays of $(NbN/TiN_x)_{N(\geqq 4)}$/NbN junction stacks using the new etching technique and will report electrical characteristics for fabricated junction arrays.