NbN FILM DEVELOPMENT FOR PHEB DEVICES

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Up until recently, the thin-film NbN samples used by most PHEB research groups across the world had been produced in Moscow (MSPU). In the last year, we have developed a process for fabricating a thin NbN film at the National Institute of Standards and Technology in Boulder, CO. A two-fold approach can be taken. The first is to maximize the critical temperature of the superconducting device (growing thicker film) at the expense of IF bandwidth whereas the second approach focuses on maximizing the IF bandwidth at the expense of the critical temperature. At NIST we are concentrating on both approaches. We have developed a film deposition process utilizing our DC reactive magnetron sputtering chamber. By current biasing the RF plasma in a mixture of Ar and N_2, while using a Nb target, we can control the film stoichiometry and produce films with thicknesses of 5 nm. The films are deposited on MgO substrates which are heated to about 800°C during deposition. A typical T_c is about 10 K and the transition width is very small (0.5 K). There is no doubt that films of thickness of 10 nm or even thinner with T_c of 14 K can be grown on either sapphire or MgO. The films are then evaluated by measuring their superconducting characteristics as well as their thickness and surface roughness using AFM analysis.

PHEB devices are fabricated on the films to study their performance as HEB mixers. The device fabrication process at UMass/Amherst involves lift-off lithography of the antenna (gold), and Reactive Ion Etching (RIE) or wet etching of the NbN. I-V characteristics and noise temperature measurements are performed on the devices in order to classify their quality for PHEB applications. A detailed summary of the measurements performed on the films and devices will be presented at the symposium.