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In-situ study of Nb oxide and hydride for SRF cavity applications using aberration-corrected STEM and electron energy loss spectroscopy RUNZHE TAO, ROBERT KLIE, University of Illinois at Chicago, YOONJUN KIM, DAVID SEIDMAN, Northwestern University, LANCE COOLEY, ALEXANDER ROMANENKO, Fermi Lab, UNIVERSITY OF ILLINOIS AT CHICAGO COL-LABORATION, NORTHWESTERN UNIVERSITY COLLABORATION, FERMI LAB COLLABORATION — We present an atomic-resolution study of the effects that a 48 hour bake at 120 °C in vacuum has on the high-field properties of Nbbased SRF cavities. This bake results a significant increase in the high-field quality factor Q, reversely, 800 °C bake for 2 hour reduces the H_{c3}/H_{c2}-ratio of cavities. Several mechanisms have been proposed, including an increased NbO_x surface layer thickness and the precipitation of NbH_v. Using a combination of atomic-resolution Z-contrast imaging and electron energy-loss spectroscopy with in-situ heating and cooling experiments, we examine the atomic and electronic structures of Nb and related oxides/hydrides near the cavity surface. We quantify the oxygen diffusion on surface during bake by measuring the local Nb valence using EEL spectra. Also, we demonstrate that hydrogen atoms incorporated into the Nb crystal, forming β -NbH precipitates, can be directly visualized using annular bright field imaging in our aberration-corrected JEOL ARM-200CF. Finally, the effects of the 800 °C baking process on the local hydrogen and other impurity will be examined by in-situ heating and cooling experiments. Our results will be combined with atom-probe tomography to develop a 3-D impurity and phase profile of Nb near the SRF cavity surface.

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