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Magneto-optical imaging of field profile on niobium surface with microstructures of niobium hydrides and a single grain boundary

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Improvement of the quality factor (Q-factor) of superconducting radio-frequency (SRF) cavities, usually made from Nb, for the acceleration of charged particles is desired practically, because the energy consumption by the dissipation in SRF cavities leads to the increase of the cooling cost. Since the dissipation by a motion of vortex (quantized magnetic flux) cause a residual surface resistance even at very low temperatures (~ 2 K), removal of vortices from a SRF cavity may make Q-factor better. However, there remain small amount of vortices even in the cooling with a magnetic shield, because the expulsion of vortices from superconducting Nb is not perfect due to unintended pinning. Therefore, exploration of the origins of the pinning is important. To study what kind of defects or microstructures influence on the pinning of vortices, we have observed magnetic-field profiles by a magneto-optical imaging technique on a Nb surface with microstructures, formed by the precipitation of niobium hydrides during a cooling into cryogenic temperatures, and with a single grain boundary. In the presentation, experimental results indicating that the grain boundary works as a guide for the vortex motion in some conditions and the surface microstructures trap vortices considerably.

Keywords: vortex, Niobium, Grain boundary, Magneto-optical imaging