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HTS coatings for the FCC-hh collider beam screen

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The baseline design of the FCC-hh beam screen is based on an octagonal shaped stainless steel tube coated in its interior with copper. The surface impedance of the beam screen has a strong impact on the beam stability. In the foreseen operating temperature range between 40 K and 60 K the intended coating might not guarantee an impedance sufficiently low for a stable beam. This motivates the exploration of high-temperature superconducting coated conductor (HTS-CC) tapes as an alternative coating approach since they promise lower surface impedance than copper under the required operating conditions. HTS-CC are a approx. 1 micron thick epitaxial layer of $\text{ReBa}_2\text{Cu}_3\text{O}_{7-x}$ ($\text{Re} = \text{Y, Gd}$) deposited on top of flexible metallic substrates (typically stainless steel or hastelloy) which are produced in kilometers length. We are investigating the capabilities of HTS-CCs as a beam screen under the extreme conditions of FCC-hh. Characterisation of samples from different manufacturers under RF fields, intermediate temperature and high magnetic fields has started. The surface resistance is evaluated using the classic fluxon model. Also the secondary electron yield of these samples is being measured. Samples will also be irradiated with synchrotron radiation and their superconducting properties re-measured following irradiation. Finally a setup to characterise the strain field distribution in the HTS-CCs after welding to the vacuum chamber in order to detect possible disturbances of the electric current field density and possible mechanical fatigue is under construction.

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