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Study on the laser treatment of Nb and Nb₃Sn thin films on copper substrate with a kW nanosecond fiber laser

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Surface annealing using intense nanosecond laser pulses is an emerging technique for SRF cavities. This technique can effectively reduce the cavities' surface defects and improve their RF performance. However, previous studies in this field limited themselves on solid state lasers or gas lasers, which have very low average power and are not practical for processing actual SRF cavities with \sim m² inner surface area. IMP innovatively built a practical whole-cavity processing system with a kW-level nanosecond fiber laser, which is designed to process an SRF cavity within a working day. In this work, the system design and feasibility analysis will be given, together with the comparison between pristine Nb thin film samples on copper substrates and their fiber laser processed counterparts. The results show that our fiber laser system can deliver comparable surface treatment as that from the solid-state laser system, but with higher efficiency. The authors believe such results could boost the application of laser surface annealing technique in the particle accelerator community.

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Footnotes

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