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Plasma electrolytic polishing @ INFN: a versatile surface treatment for accelerator components and additive manufacturing

Tuesday 23 September 2025 14:30 (3 hours)

Plasma Electrolytic Polishing (PEP) is under active development at INFN-LNL as a flexible, environmentally friendly alternative to conventional electropolishing (EP). Since 2019, our research has focused on optimizing PEP for a variety of accelerator-relevant materials and geometries, ranging from standard planar samples to complex components, including parts fabricated via Additive Manufacturing (AM). Unlike EP, PEP uses diluted salt-based electrolytes, avoiding hazardous acids, and allows for high removal rates (up to 30 μm/min for Cu) with low surface roughness (Ra<50 nm). These properties make it highly suitable for applications requiring excellent surface finish and minimal contamination, such as RF structures and vacuum components. This contribution presents an overview of the various developments achieved with PEP at LNL. These include treatments of AM stainless steel and copper structures, inner copper conductors, and Cu drift tubes for LINACs. The synergy between PEP and AM surfaces has also been explored, with promising results indicating the potential for replacing multi-step post-processing chains with a single PEP step. Furthermore, custom electrolytes and process parameters have been developed and patented for multiple metals including Cu, Nb, Al, and stainless steels. The contribution highlights the versatility of PEP across multiple materials and geometries, its scalability, and its prospects for integration into accelerator component manufacturing workflows.

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Footnotes

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