

Laser ablation surface engineering for particle accelerators

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High intensity charged particle accelerators are suffering from beam induced electron multipacting and electron cloud, electron multipacting effect is also a problem for radio-frequency resonators and vacuum wave-guides. One of the most efficient ways to mitigate such problems is developing and applying a surface with low Secondary Electron Yield (SEY). A low SEY < 0.9 surface can be produced on copper, aluminium and stainless steel surfaces with Laser ablation surface engineering (LASE) [1,2]. Further reduction in SEY down to SEY = 0.6 can be achieved by bakeout, electron and/or photon bombardment [3]. The efficiency of this technology has been demonstrated in a machine test in SPS at CERN [4]. Presently, the LASE technology is a baseline design for the Future Circular Collider with 200-km of vacuum chamber to be treated, and many other small and large-scale applications around the world, where the Laser Industry could be involved.

[1] R. Valizadeh, O.B. Malyshev, S. Wang, *et al.* Low secondary electron yield engineered surface for electron cloud mitigation. *Appl. Phys. Lett.* 105, 231605 (2014).

[2] R. Valizadeh, O. Malyshev. Apparatus and methods relating to reduced photoelectron yield and/or secondary electron yield. Patent publication number WO2015189645 A1. 17th Dec. 2015.

[3] R. Valizadeh, O.B. Malyshev, S. Wang, *et al.* Reduction of Secondary Electron Yield for E-cloud Mitigation by Laser Ablation Surface Engineering. *Appl. Surf. Sci.* 404, 370–379 (2017).

[4] S. Calatroni, E. Garcia-Tabares Valdivieso, H. Neupert, *et al.* First accelerator test of vacuum components with laser-engineered surfaces for e-cloud mitigation. *Phys. Rev. Acc. and Beams* 20, 113201 (2017).