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Copper surface treatment with deep UV ultrafast laser for improved photocathode photoemissive properties

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Surface nanostructuring is a promising approach when it comes to improving the quantum efficiency (QE) of materials for electron accelerator purposes at CERN. This is due to the plasmonic effect taking place in metallic materials at the nanoscale, when an electromagnetic wave interacts with a sub-wavelength feature. Ultrafast laser surface nanopatterning can be an efficient and times saving method for producing such nanostructures. We conducted a study of nanostructuring of copper surfaces with a deep-UV femtosecond laser. A wide range of fabrication parameters (speed, laser fluence and repetition rate) were tested. At different energy regimes we were able to produce Laser Induced Periodic Surface Structures (LIPSS), as well as spherical nanoparticles of tunable size and other types of periodic nanoscale features. Sub-wavelength periodic structures yield higher exaltation of surface plasmons under matching excitation wavelength, resulting in a potentially significant increase in QE of copper photocathodes. Moreover, by using the same laser source for nanomachining and photoemission, one can easily integrate the technology in and existing photoinjector.

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Footnotes

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