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Deposition and processing of thin-layer lead cathodes for hybrid niobium superconducting RF photoinjector

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The idea of a Nb/Pb hybrid superconducting electron injector was proposed within the last decade [1]. Thin-layer lead cathode was coated onto the rear wall of a 1.6 cell RF electron photoinjector built in TESLA technology. It is destined for superconducting linacs of free electron lasers (FELs) which provide up to 1 mA of mean current in 10^5 Hz repeated, 1 nC bunches to a FEL undulator. Though the usefulness of this solution was proved in a single proof-of-principle experiment [2] the quantum efficiency (QA) of different photoinjectors was not reproducible and depended on the cathode preparation. The tests indicated that reaching a high layer smoothness at its sufficient thickness (1-2 μm) is necessary to operate such injector. Though UHV arc lead coating on niobium substrate assured the highest QA values reached so far [1] the biggest disadvantage of this method is the presence of surface extrusions formed by lead droplets detached from the cathodes of arc devices. To overcome this problem two approaches were proposed at NCBJ within last year: 1. fast coating in a short planar arc device followed by Pb layer melting and recrystallization in a pulsed plasma ion beam in a rod plasma injector and 2. lead deposition in arc device equipped with angular magnetic filter to remove microdroplets from lead plasma stream. The first procedure was effective in smoothing only the lead surface extrusions with lateral size up to ca.25 μm using Ar^+ ion pulses of 1.5 J/cm^2 fluency. Further increasing of the fluency led to discontinuities of a 2 μm thick layer. Works on improving the niobium surface wettability with molten lead are underway. Deposition with droplets filter led to droplets density reduction in a surface layer to below 10/mm^2, their size to ca 10 μm and to satisfactory cleanliness of the film. The obtained Pb layers will be checked as photocathodes for QA and dark current in the RF injector at Helmholz-Zentrum Dresden-Rossendorf.

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[1] J. Smedley, T. Rao, J. Sekutowicz, *Physical Review Special Topics – Accelerators and Beams* **11** (2008) 013502.
[2] J. Lorkiewicz, R. Nietubyć, M. Barlak, R. Mirowski, A. Bartnik, J.Kostecki, J. Sekutowicz, P. Kneisel, A. Malinowska and J. Witkowski., *Physica Scripta T* (2014), in press.

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Threshold fluence of ultra-short VUV laser pulse for structure modification of gallium arsenide

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Damage processes induced by laser pulses lead to the formation of specific morphological structures of sizes in micrometer and nanometer scales [1,2]. In the current work we present the investigations of gallium arsenide modified by femtosecond laser pulse [3]. The irradiations sources were free electron lasers [4,5] operating in the wavelength range of 32-51 nm.

The samples were examined by the interference-polarizing microscopy and atomic force microscopy to determine threshold values of laser beam fluence for creation of different morphological structures.

The X-ray diffraction was used to examine the structural changes in the near-surface layer in irradiated region. The structural characterization was done with synchrotron radiation at the DORIS W1.1 beamline in Hasylab with the monochromatic beam of wavelength 1.54056 Å. The measurements were recorded in a 2θ scan mode in the grazing incidence geometry. The ω-2θ scans were also recorded in order to find the structural changes in the near-surface layers affected by the irradiation.

The deformation stress was studied in back-reflection geometry by means of white beam projection topography at the F1 experimental station of DORIS in Hasylab.

[1] Pelka J.B, *Rad. Phys Chem.* **78** (2009) S46-S52.
[2] R. Sobierajski *et al., Proc. SPIE* **7361** (2009) 736107.
[3] R. Sobierajski *et al., J. Instrumen.* **8** (2013) 02010
[4] T. Shintake *et al., Nature Photon.* **2** (2008) 555–559
[5] V. Ayvazyan *et al. Phys. Rev. Lett.* **88** (2002) 104802.