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Surface modification of gold nanolayers by highly charged xenon ions

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The studies on creation of surface nanostructures on metals, semiconductors and insulators are important for development of new technologies for production of microelectronic devices [1]. Structures of nanometric sizes can be created, for example, in collisions of highly charged ions (HCI) with surfaces of various materials. In this case different parameters of the ion beams, irradiated materials and processing conditions lead to miscellaneous characteristic modifications obtained on a material surface (see [2] and reference therein). In order to fully understand this process systematic measurements of surface modifications using HCI ions under various experimental conditions and with different ions/materials are needed.

In this work surface modifications caused by irradiation of 100 nm gold nanolayers using highly charged Xe^{q+} (q+=25, 30, 35, 36, 40) ion beams have been studied. The samples were irradiated at the Kielce EBIS facility (Jan Kochanowski University, Kielce, Poland) [3]. The AFM images of irradiated surfaces allowed for the first time to unambiguously identify nanostructures in the form of craters and hillocks on the gold surfaces [4, 5]. The experimental results were compared with the theoretical calculations using: micro-staircase model [6], the inelastic thermal spike (i-TS) model [7], molecular dynamics (MD) simulations [8], and compared with the experimental data obtained for slow single ionized Xe^{+} hitting Au surface [9]. Predictions of the micro-staircase model clearly showed that both the kinetic energy and the potential energy of the HCI have an influence on the type and size of nanostructures obtained on metallic surfaces. In this model interplay of these two energies is described by the critical ionic velocity. For the ionic velocities lower than the critical one the model assumes an appearance of the hillocks, while for the larger velocities a dominant surface structures are craters.

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