

# Nanostructuring of gold nanolayers by an impact of low-energy highly charged xenon ions

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**Synopsis** In this work we have systematically studied process of energy deposition and formation of nanostructures on metallic (Au nanolayer) surfaces as a result of the irradiation with single low-energy highly charged xenon ions (HCI). Well pronounced modifications of the surfaces in form of craters were observed. We found that, in the systems considered, the kinetic energy influences the crater depth, while the potential energy affects the crater size at the surface. This finding showed that for gold nanolayers the potential energy plays important role in the nanostructures creation, which was not expected for metallic surfaces.

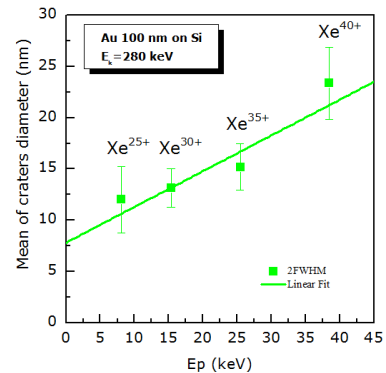
Modification of metal, semiconductor and insulator surfaces by an impact of single (i.e. each ion creates nanostructure) low-energy highly charged ions (HCI) is of great importance for developing new technologies and has the potential to introduce novel nanostructures and material properties not achievable by any other material processing methods [1].

When HCI approaches to the surface its kinetic and potential energy (the sum of binding energies of the removed electrons) is dissipated at the surface which leads to structural modification of the outermost surface layers and a nanostructure creation [2].

In this work, modifications of Au nanolayers deposited on a crystalline silicon Si (100) wafers caused by HCI xenon were analyzed. The nanolayers were irradiated with  $Xe^{q+}$  ( $q=25-40$ ) ions in the energy range hundreds of keV (nuclear stopping power regime) at a fluence of about  $10^{10}$  ions/cm<sup>2</sup> [3, 4]. After irradiation the nanolayers were investigated using atomic force microscope. Well pronounced modifications of the nanolayers surfaces, due to impact of the HCI ions, in the form of craters, have been observed for the first time for such systems. As a result dependences of the potential energy, kinetic energy, and nanolayer thickness on the size of the nanostructures were measured systematically.

The results are consistent with previous experimental data and MD simulations for single ionized Xe and crystalline gold surface [5]. We confirmed that the crater formation is due to HCI

kinetic energy deposition, but we also found that role of HCI potential energy is very important (see Figure 1). The results showed that kinetic energy has mainly influence on the crater depth, while potential energy of the HCI change the crater diameter at the surface. This can be explained by very fast deposition of the potential energy just at the surface (within a subnanometer depth). The results were qualitatively confirmed by preliminary 3D i-TS calculations [6].



**Figure 1.** Dependence of the craters diameter on  $Xe^{q+}$  potential energy.

## References

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