Properties of Au/$MoSe_2$ heterostructures

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For layer materials applications metallization is extremely important. To understand how additional metal layer affects semiconducting $MoSe_2$ flakes we studied Au/MoSe2 heterostructures.

Thin layer of gold was thermally evaporated on 1-4 layer mechanically exfoliated $MoSe_2$ on SiO_2/Si substrate samples to obtain Au/$MoSe_2$ heterostructures. Topography of the heterostructures were determined by atomic force microscopy (AFM) measurements. On the surface self-assembled nanoislands of Au were detected. Nanoislands average size and distribution on the surface strongly depends on $MoSe_2$ sample thickness and Au layer size. Example of AFM image Au/$MoSe_2$ heterostructure is presented in *Figure 1*. Similar structures were already observed for another layered transition metal dichalcogenides Au heterostructures – MoS_2 [1]. Their presence was explained in terms of the heat transfer processes which affects gold particle mobility on flakes surface.

In this work we investigate how $MoSe_2$ Raman scattering is affected by creating heterostructures with Au presence. General observation shows that Raman scattering spectrum has less mode present at 532 nm excitation. The most significant mode for heterostructures is A_{1g}, but its energy decrease, intensity falls down and width broadens. We also study the luminescence of 1L MoSe2 covered with Au nanoislands and their influence on the low-energy Raman modes of the material.

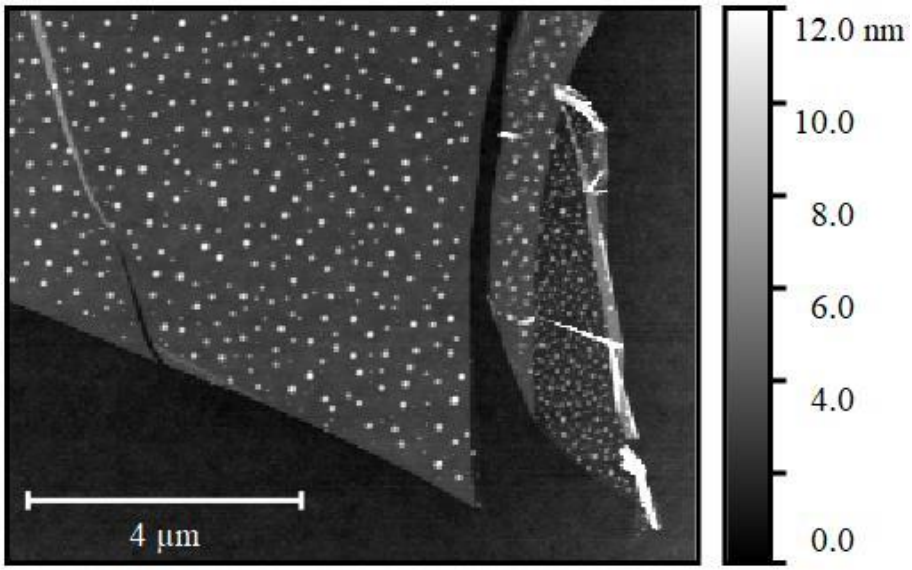

Figure 1: AFM measurement of Au/$MoSe_2$ nanostructure. Comparison of nanoisland size and density distribution for 3 and 1 layer thick $MoSe_2$ sample (left and right part of sample respectively) and 1 nm Au deposited.

[1] K. Gołasa, M. Grzeszczyk, J. Binder, R.Bożek, A.Wysmołek and A. Babiński, *AIP Advances* **5**, 077120 (2015).