In-situ and analytical transmission electron microscopy: mechanism of material transport and crystallization during the metal induced layer exchange (MILE)

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When an a-Si / Al (or Ag) / glass stack is heated at a temperature of 400-500 °C, Si diffuses into the Al layer followed by growth of large crystalline Si grains in the metal layer resulting in a new stacking order of type metal(+Si) / c-Si / glass. This surprising phenomenon is called metal-induced layer exchange (MILE) and can be exploited for fabrication of polycrystalline semiconductor thin films with great potential for applications in thin film solar cells and transistors. The phenomenon has been known and researched for 40 years but the microscopic mechanism of the material transport is not completely understood. In this talk results obtained using in-situ and analytical TEM regarding the microscopic mechanism of material transport and crystallization during MILE will be presented.

Controlled morphological transformation of hollow oxide nano-structures upon *in situ* annealing in a transmission electron microscope

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Hollow oxide nanostructures are materials with a high technological potential for applications in various fields ranging from nano-optics, catalysis, sensing, energy storage, microreactors to drug delivery. Currently, there is an interest in the development of methods to fabricate hollow oxide nanostructures of a wide variety of materials. Among these hollow structures, oxide nanotubes are considered as potential building blocks for nanoelectronics. Up-to-now, the majority of the synthesis methods produce oxide nanotubes which suffer from short length and poor organization. Recently, a fabrication method of highly organized ultra-long metal oxide nanotube (length-up to several centimeters) based on the thermal oxidation of metal nanowire arrays selectively grown on nanograting template structures has been developed. This route, based on the nanoscale Kirkendall effect, is also extendable to periodic zero-dimensional hollow nano-objects. In this contribution we present an extensive structural study of the morphological transformation of oxide nanotubes upon *in situ* annealing in a transmission electron microscope. Based on this, the role of oxygen on the fundamental mechanisms occurring during the formation of such oxide nanotubes will be discussed. These results show the structural transformation and copper ions diffusion inside an oxide nanotube due to the effect of heating. The experiments were performed to temperatures higher than 600°C and done using a dedicated Gatan 652 heating holder. Further *ex situ* studies revealed the chemical nature of the Cu based surrounding core-shell structure.