From Crystalline to Vitreous 2D Silica - a Complementary nc-AFM and STM Study

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Recently, we reported on the atomic structure of a vitreous silica film on Ru(0001) using non-contact atomic force microscopy (nc-AFM) and scanning tunneling microscopy (STM) [1, 2]. For the first time, it was possible to verify Zachariasen's continuous random network [3] in real space. The existence of a 2D silica glass on a graphene support has been shown by scanning transmission electron microscopy [4] suggesting that further 2D glass systems may be prepared. The investigation of 2D glass models provides the unique possibility to study unexplored properties of amorphous materials.

Here, we simultaneously applied nc-AFM and STM using a tuning fork sensor. All experiments were performed at low temperature in ultra-high vacuum. We successfully prepared crystalline and amorphous silica films on Ru(0001). The different imaging contrasts obtained in nc-AFM and STM will be discussed and the complementary information from both operating modes will be analyzed in a thorough statistical analysis. The data is then compared to diffraction methods as well as to theoretical models for the different phases.

By carefully controlling the growth parameters we even managed to prepare films with neighbouring crystalline and vitreous phases of 2D silica at the same sample spot. The interface and the gradient of the ring distribution will be provided. This model system allows now the unique possibility to study glass and the glass transition with atomic resolution in real space.

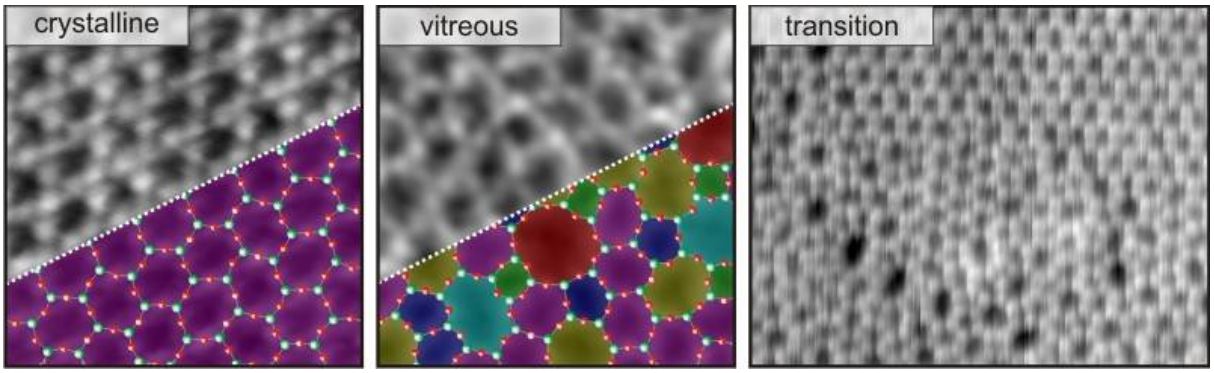

Figure: STM images - crystalline, vitreous: 3.5 nm × 3.5 nm, V_S = 100 mV, I_T = 100 pA, partially covered with Si and O-positions, transition: 9.0 nm × 7.0 nm, V_S = 2 V, I_T = 100 pA.

References

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