In-situ GISAXS and x-ray reflectivity studies of the dewetting of thin metal films deposited on amorphous SiO_2

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Isolated thin metal films are unstable and they tend to form clusters. In the case of thin metal films deposited onto a substrate the interaction between the metal atoms and the substrate is crucial for the stability of the system. In this contribution we show how Nickel films, deposited in-situ onto amorphous SiO_2 substrates, behave under a thermal treatment. At relative low temperatures (about 350°C) the films brakes and at the end of the process pure metal clusters are formed. The formation dynamics and the morphology of the final clusters strongly depend on the initial thickness. For small thickness the system will produce small clusters with nanometric dimension while thicker films will result in large well separated clusters.

For the characterization of this process we have used x-ray reflectivity, to determine the refractive index profile before and after the dewetting process, grazing incidence small angle x-ray scattering, to study the formation of the clusters, and, at the end, the morphology of the films have been studied by atomic force microscopy.

Our data show that these two regimes have a complete different behavior and lead to intrinsically different clusters. In the case of thin films (less than 5 nm) a thin wetting layer is always present while in the case of the thicker films the metal clusters are completely isolated.

Theoretical models for explaining this behavior will be presented and discussed.