Structure and phase separation in ultrathin bimetallic alloys

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Intermetallic alloys are of interest for their structural, chemical and magnetic properties. Among them, Fe-Ni alloys have a special place. The rich $Fe_{1-x}Ni_x$ phase diagram as a function of stoichiometry and temperature features a region of immiscibility at around the invar composition x_{Ni} = 0.30. However, due to the suppressed mobility, the phase separation is hindered in bulk samples [1]. Here, we show that Fe-Ni thin films grown on W(110) display a pronounced structural separation at moderate temperatures (at around 300 °C) near the micron scale (figure – left). Interestingly, the fcc-bcc coexistence can be observed down to the monolayer limit [2]. The Ni-enrichment on the surface and the high surface diffusion are found to be responsible for the observed microstructure. Furthermore, time-resolved measurements as a function of temperature indicate that the rate-limiting energy barrier is about 1.6 eV (figure – right). We identify this barrier with the vacancy-formation energy in the bcc phase. I will conclude the presentation with a discussion of the magnetic state of the hetero-structured film.

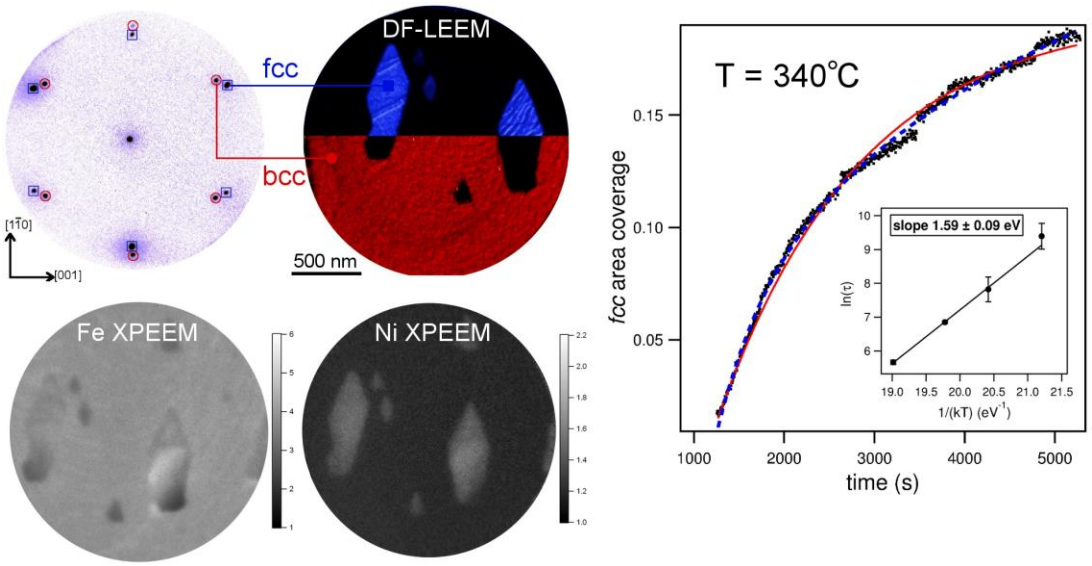

Figure caption: (Left) LEED, dark-field LEEM and XPEEM data of the fcc-bcc phase-separated Fe-Ni film on W(110). (Right) The temperature-dependent dynamics of the phase-separation indicates an energy barrier of about 1.6 eV.

References:

[1] J. Zhang, D. B. Williams, J. I. Goldstein, Metall. Trans. A **25**, 1627-1637 (1994).

[2] T. O. Menteș, A. Sala, A. Locatelli, E. Vescovo, J. M. Ablett, M. A. Niño, e-J. Surf. Sci. Nanotech. **13**, 256-260 (2015).