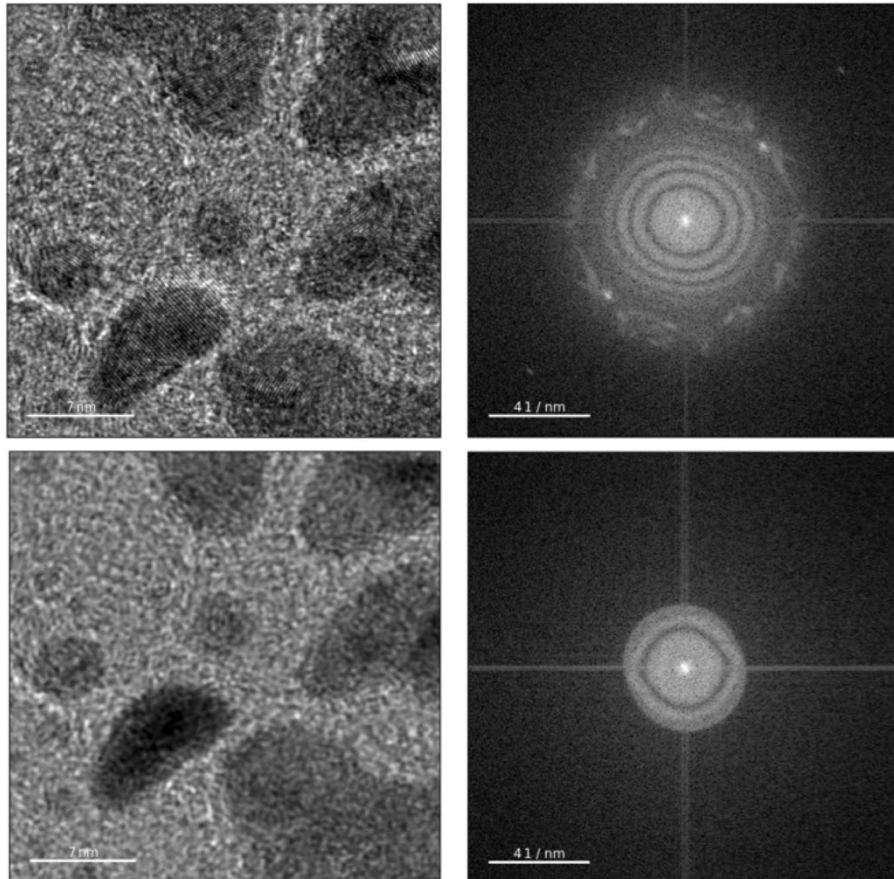


Assignment Module 8 Phase contrast (2) – Corrections

Prompt 1:

Below are two acquisition of images of gold nanoparticles on carbon film together with the FFT of the image. Only one thing was changed on the TEM between the two acquisitions. One point per question.



1- What was changed on the microscope?

In the second case an objective aperture was inserted.

2- Why are lattice fringes visible on the first image and not on the second one?

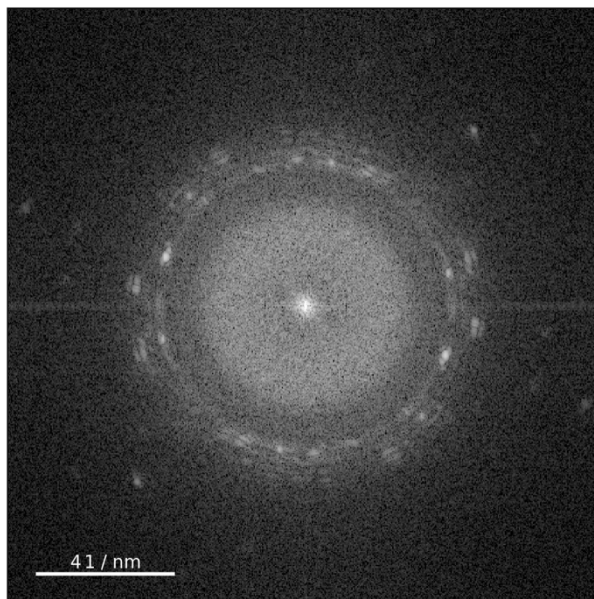
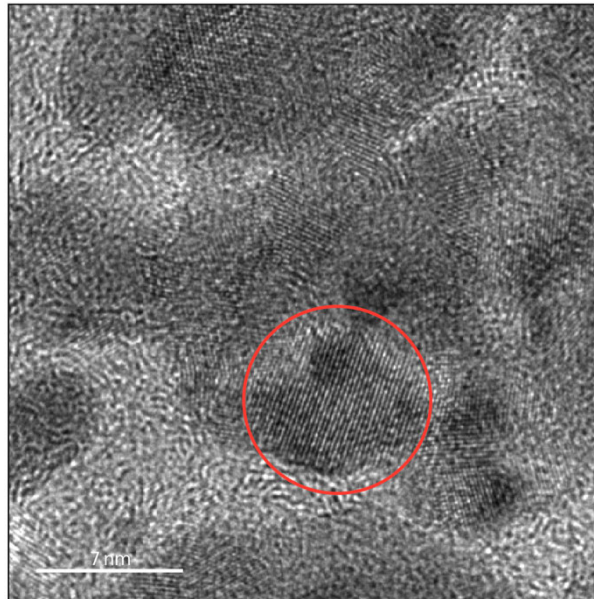
The objective aperture cuts out the lattice reflections that would allow one to obtain a high-resolution image, preventing the formation of the interference pattern between the direct and diffracted beams.

3- Evaluate the maximum resolution attainable in the second case

The radius of the aperture is $r^ = 2(1/\text{nm})$ hence the max resolution is $1/r^* = 0.5\text{nm}$*

Prompt 2:

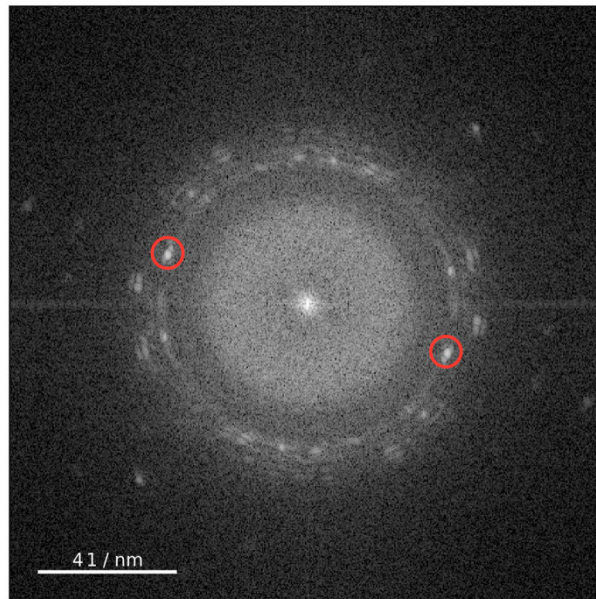
Here is the picture of gold nanoparticles on carbon film and the FFT of the image.



1- Why do some grains exhibit a dot pattern while other show lines?

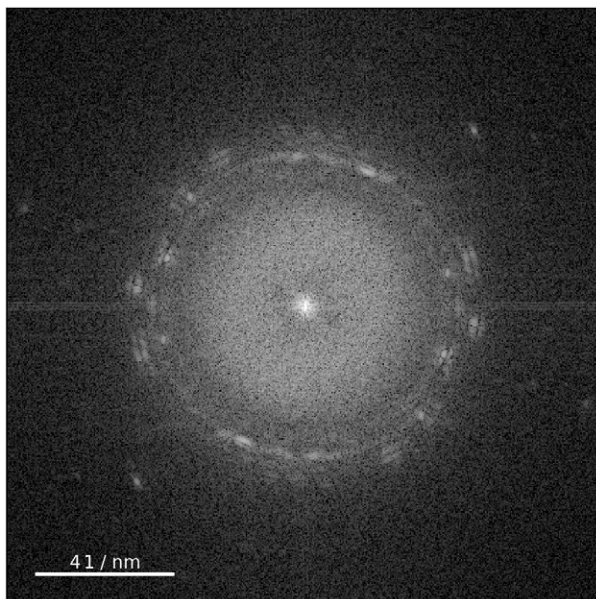
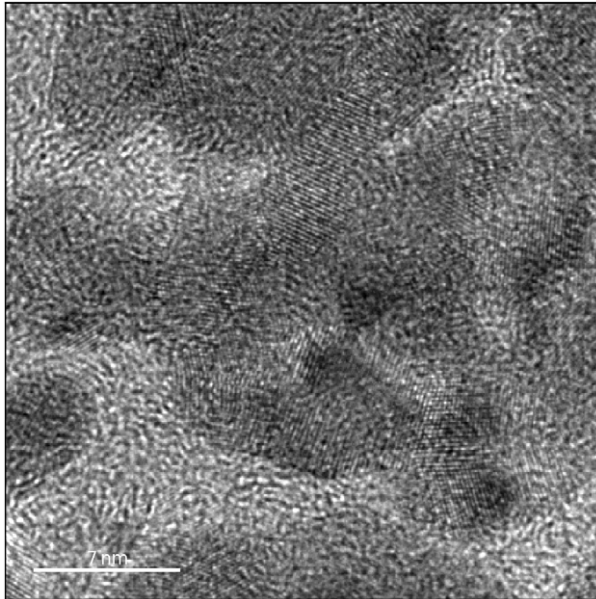
Those grains have different orientations. The one with dots are in zone axis while the one with line are in a systematic row (or 2 or 3 beam case) condition.

2- Identify on the FFT of the image the dots corresponding to the particle circled in red (upload an annotated image)



Prompt 3:

This are an image and the corresponding FFT acquired on the same region of the specimen as before.



1- Only one parameter was changed on the microscope between this image and the one of prompt 2. Which parameter is it?

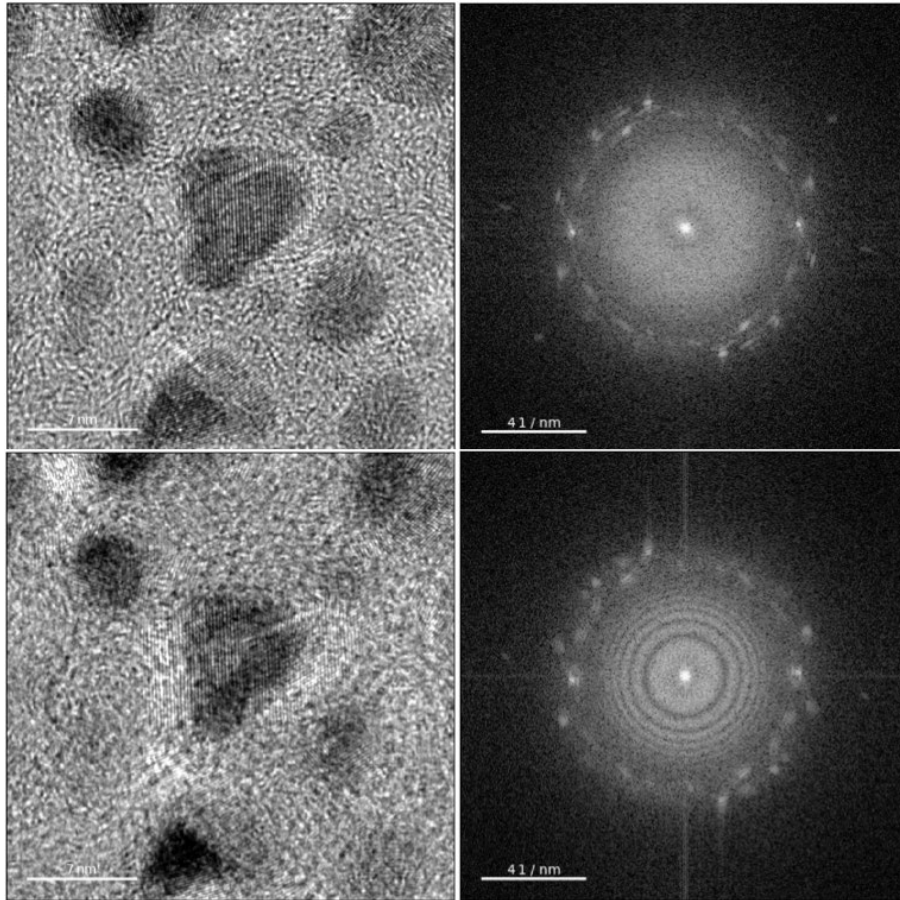
The defocus was changed.

2- The fringes are now not well visible on the particle that was circled in red. Why?

Changing the defocus changes the phase contrast transfer function and hence the position of the dark rings which correspond to spatial frequencies that are not transmitted in phase contrast. In this case, the spatial frequencies corresponding to the fringes of the considered particles fall exactly in one of those black rings, and hence the fringed are not visible.

Prompt 4:

This shows two images of the same gold nanoparticles on carbon film together with the FFT of the image



1- What was changed on the TEM between top and bottom acquisition?

The defocus of the objective lens was changed. It is stronger in the second image.

2- In the bottom image, lattice fringes are visible outside of the particle. What is the TEM parameter that was set badly to arrive to this, and how is the effect called?

*The defocus is too high and it produces **delocalisation**.*