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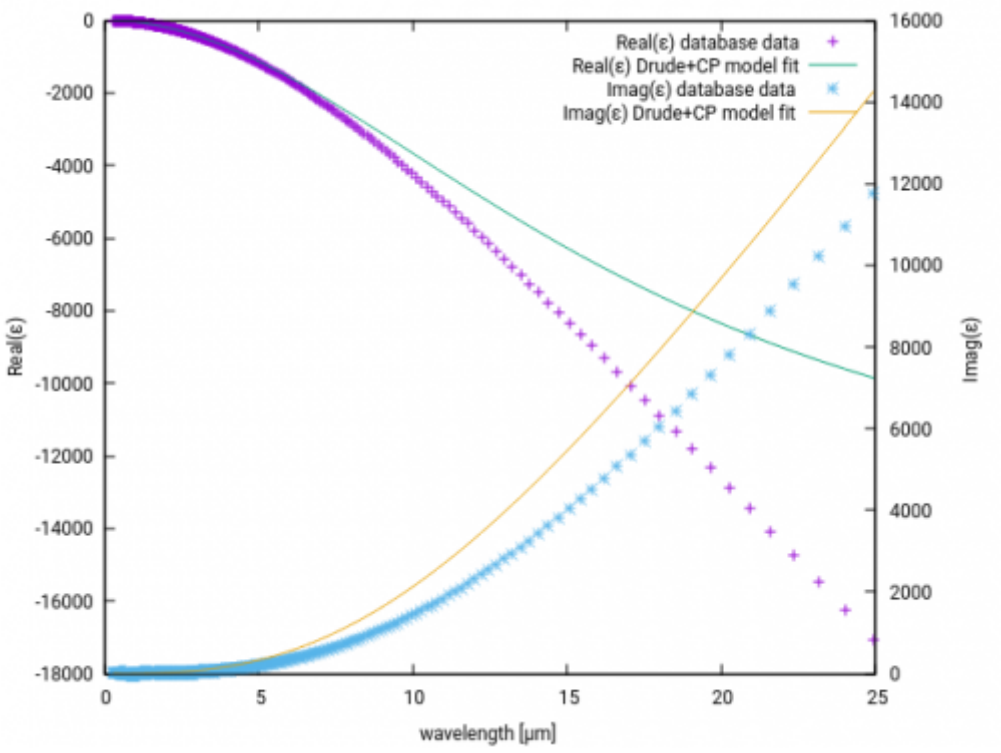
Infrared scattering SNOM

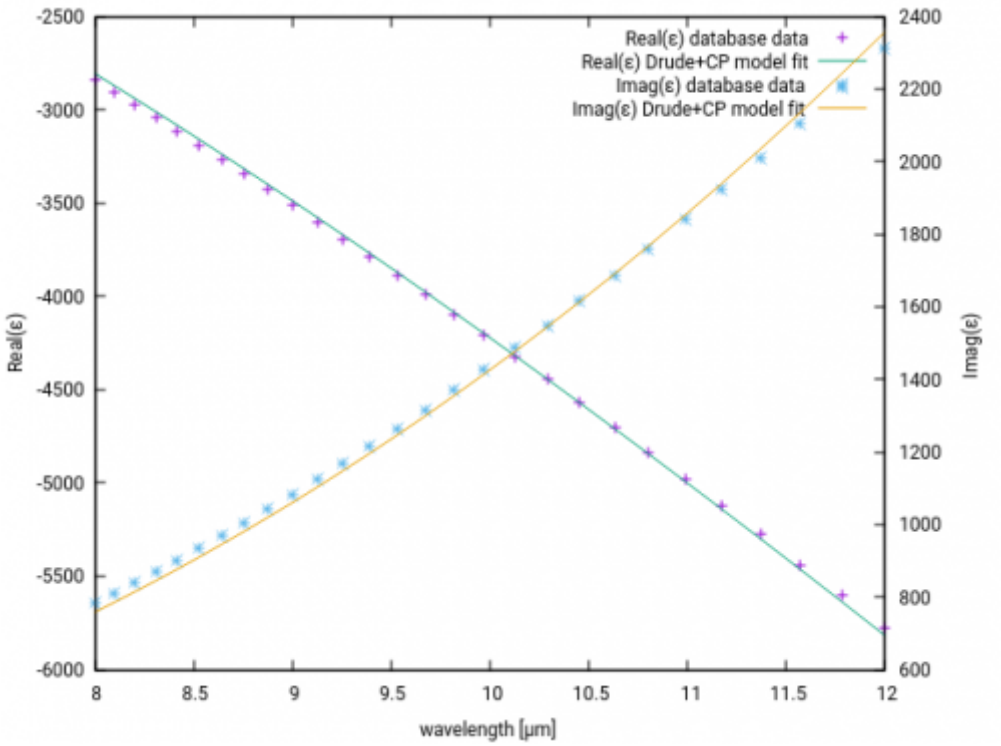
Scattering SNOM is an optical technique that allows obtaining information about sample optical properties with nanoscale resolution. This is based on the local field enhancement effect, similar to the TERS. However, here we don't need to collect a very small Raman signal, so the technique is easier to work even with not so ideal experimental conditions.

The most popular variant of this technique at present is the infrared scattering SNOM, which has the large benefit of obtaining some chemical information. So far it seems to be the most suitable technique for chemical resolution in the field of Scanning Probe Microscopy. Using FDTD we can simulate the performance of different probes manufactured for infrared SNOM measurements.

First aspect to handle if we want to work in mid-infrared are the optical parameters. Using databases as Refractiveindex.INFO we can get the right values of the optical constants for wide range of wavelengths. If we want to use the dispersive metal models, like those discussed in Media section, we need to adapt also their parameters. Below we can see and example of how the literature parameters fitted for 400-800 nm wavelength range might deviate from experimental data if we are in infrared region.



The solution is to fit a suitable dielectic function model to the database data and use this in the calculation. For metals in infrared a Drude model is typically recommended. This can be handled via the PLRC and ADE algorithm, for example by setting the strength of critical points to zero in any of the Drude+CP algorithms. The dielectric function fitted to a particular wavelength range, here around 10 microns, looks already much better:



As an example, typical fit results for this material and wavelength region were (in the GSvit input format including the dispersive model type)

```
5 1 0 1.232e+16 5.58e+13 0 -1.09115 4.20737e15 2.35409e15 0 -1.18299
3.88123e15 0.452005e15 .
```

Note that in fact only Drude terms are used in this case, as the weights of the CP terms were here set to zero.

Sample parameter file: IR SNOM probe.
A simulation of a long SNOM tip illuminated by infrared wavelength. Note that the metal properties are not adapted for the correct wavelength range.