Spatial organization of metallic nanowires for advanced photonics

Essentially everybody, being a child and waiting on a platform at the railway station did experience the fact that the noise in the rails appeared when the train was approaching the station. Some of us perhaps put our head close to the rails to hear it more easily. Why is that happening? It is because sound propagates much faster in metal than in the air, thus the sound wave arrives earlier. One can say that we have here an effect of excitation propagation (in this case propagation of the sound wave) on distances that are much, much larger than the wavelength. This project is based on a very similar, if not identical, mechanism, but associated with light. Since the wavelength of light is about 500 nm, the same concept requires using much smaller objects for probing energy propagation. We plan to use metallic nanowires, their diameter is smaller than the wavelength of light, while their lengths – significantly larger. Apparently, when laser is used to illuminate one of the ends of such a nanowire, it is possible to observe energy propagation to its other end. This propagation is facilitated by excitation of electrons, called plasmon. Experimentally, the propagation is evidence by appearing of emission of light from the end of the nanowire, which is not illuminated by the laser. In our project we intend to go one step further and use the emission for subsequent excitation of plasmons in a second nanowire, which will be placed close to the first one. It is obvious, that in order to study such systems, we have to develop ways of placing two nanowires close to each other at a very small distance. Our strategy relies on using chemical hooks that will be precisely deposited on a surface. If we succeed, we could say that it is possible to transfer light energy in metals at distances 100 times larger than the wavelength of light.