Silver nanowires synthesis with no by-products

Networks of silver nanowires (AgNWs) are used for building transparent electrodes in applications that span from touchscreens to solar cells[1-3]. In comparison to doped metal oxides, AgNWs are much cheaper and faster in production and they can also be used for the realization of flexible touchscreens and wearable electronics. The most common way to produce AgNWs is the so-called polyol synthesis, in which silver nitrate ($AgNO_3$) is solubilized in ethylene glycol (EG) in presence of a stabilizer (polyvinylpyrrolidone, PVP) and a metal halide[4,5]. Such a simple and fast synthetic strategy, however, has a drawback: the production of AgNWs is always accompanied by the presence of a large amount of by-products, in the form of randomly sized and shaped Ag nanoparticles. These nanoparticles drastically decrease the performances of transparent electrodes and therefore they have to be eliminated by long and expensive steps of purification (precipitation, centrifugation, …). These purification steps drastically increase the cost of AgNWs production[4,5].

In our lab, we recently discovered a synthesis of AgNWs that results in a very high purity of AgNWs[6]. Our as-synthesized product shows an amount of impurities that is lower than the one obtained with other reported syntheses after several purification steps. Our synthesis relies on the use of freshly prepared metal halide and the control of the pressure of gasses into the reaction vessel, and, thanks to that, we can drastically decrease the time and cost of AgNWs production.

In this project we want to explore even further the role of the gas formation during the reaction and if the nature of the metal halide is a key parameter in the formation of the by-products. You will learn the chemical synthesis of silver nanowires and their characterization by means of UV-Vis spectroscopy and electron microscopy (Scanning Electron Microscopy and Transmission Electron Microscopy). You will then perform the synthesis varying different parameters (pressure of the gas, volume of the reaction vessel, nature of the halide, …) to understand how the formation of by-products can be completely suppressed during the reaction. The results of this project can be of paramount importance for the realization of very cheap electronic devices with a wide range of applications, from solar energy conversion to wearable electronics.

The project will be carried out at DIFFER, which is located inside the TU/e campus, under the supervision of dr. Andrea Baldi and PhD student Matteo Parente.

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